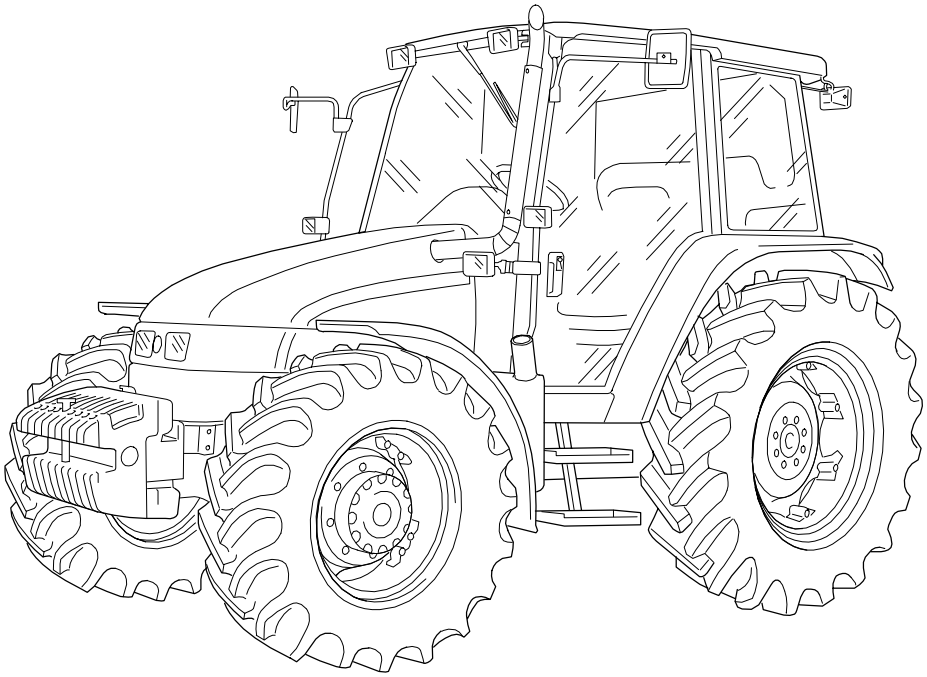
NEW HOLLAND



TRACTORS TL 70 - TL 80 - TL 90 - TL 100
SERVICE MANUAL

SECTIONS

GENERAL GUIDELINES 00
ENGINE 10
CLUTCH 18
TRANSMISSION 21
DRIVE LINES 23
FRONT MECHANICAL TRANSMISSION 25
REAR MECHANICAL TRANSMISSION 27
POWER TAKE-OFF 31
BRAKES 33
HYDRAULIC SYSTEMS 35
STEERING 41
AXLE AND WHEELS 44
CAB AIR CONDITIONING SYSTEM 50
ELECTRICAL SYSTEM 55
PLATFORM, CAB, BODYWORK 90

S E R V I C E

CONTENTS

	Page	Date
00 - GENERAL GUIDELINES		
General instructions	1-2	11-02
Safety regulations	3-4-5	11-02
Consumables	6	11-02
10 - ENGINE		
Summary	1	11-02
General specifications	2-3-4	11-02
Fuel system data	5-14	11-02
Injection pump calibration and engine performance data	6÷13	11-02
Engine block data	14	11-02
Crankshaft and engine block data	15-16	11-02
Connecting rod data	16	11-02
Piston data	17	11-02
Timing gear data	18-19	11-02
Rotating counterweights main data	19	11-02
Cylinder head data	20	11-02
Lubrication and cooling system data	21	11-02
Tightening Torques	22	11-02
Tools	23-24	11-02
Cross-sectional views of 4-cylinder engine models TL70 and TL80	25-26	11-02
Engine cooling and lubrication diagrams	27-28	11-02
Fault diagnosis	29÷32	11-02
Engine Removal - Installation	33÷47	11-02
Compression Test	48	11-02
Engine Disassembly - Assembly	49÷73	11-02
Checks and measurements - cylinder block and liners	74-75	11-02
Checks and measurements - crankshaft, bearings and flywheel	76÷79	11-02
Checks and measurements - connecting rods	80	11-02
Checks and measurements - pistons	81÷83	11-02
Checks and measurements - camshaft, tappets and valves	84-85	11-02
Checks and measurements - cylinder head	86	11-02
Checks and measurements - rotating counterweights	87	11-02
Checks and measurements - lubrication system	88-89	11-02
Checks and measurements - cooling system	89	11-02
Replacing valve guides and re-facing valve seats	90÷93	11-02
Replacing injector sleeves and support	94-95	11-02
Replacing crankshaft front seal	96÷98	11-02
Valve Clearance Adjustment	99÷101	11-02
Removal-Installation - injectors	102÷104	11-02
Removal-Installation - Bosch injection pump	105÷109	11-02
Bosch injection pump - timing	110-111	11-02
Bosch injection pump - air bleeding	112	11-02
Removal-Installation - coolant pump	113÷116	11-02
Disassembly-Assembly - coolant pump	116	11-02
Removal-Installation - thermostat valve	117÷120	11-02
Removal-Installation - radiator	121÷124	11-02
Coolant pump drive belt adjustment	125	11-02
18 - CLUTCH		
Data	2	11-02
Tightening Torques	3	11-02
Tools	3	11-02
Cross-sectional views	4	11-02
Fault diagnosis	5	11-02
Checks and measurements - clutch	6-7	11-02
Adjustments - clutch pedal	8	11-02

	Page	Date
Removal-Installation - clutch	9÷20	11-02
Clutch Overhaul	21÷24	11-02
Adjustments - clutch disengagement levers	25	11-02

21 - TRANSMISSION

CHAPTER 1 - Transmission and range gear (12x4)

Data	2	11-02
Tightening Torques	3	11-02
Tools	4-5	11-02
Cross-sectional views	6-7	11-02
Description and Operation	8	11-02
Fault diagnosis	8	11-02

CHAPTER 2 - Reverser

Data	2	11-02
Tightening Torques	3	11-02
Tools	4	11-02
Cross-sectional views	4-5-11-12	11-02
Description and Operation	6	11-02
Fault diagnosis	6	11-02
Disassembly-Assembly - clutch casing-reverser	7÷10	11-02

CHAPTER 3 - Over-Drive Unit

Data	1	11-02
Tightening Torques	2	11-02
Tools	3	11-02
Cross-sectional views	3-4-13	11-02
Description and Operation	5	11-02
Fault diagnosis	5	11-02
Removal-Installation - OVER-DRIVE casing	6	11-02
Replacing OVER-DRIVE casing	7÷12	11-02

CHAPTER 4 - Dual Command (2 Speed Power Shift)

Data	2-3	11-02
Tightening Torques	4	11-02
Tools	5	11-02
Cross-sectional views	6÷8-47	11-02
Description and Operation	10÷15	11-02
Fault diagnosis	16-17	11-02
Removal-Installation - clutch casing with Dual Command (2 Speed Power Shift)	18÷26	11-02
Disassembly-Assembly - clutch casing with Dual Command (2 Speed Power Shift)	27÷35	11-02
Control rod adjustments	36	11-02
Removal-Installation - Dual Command (2 Speed Power Shift) solenoid valve	37÷40	11-02
Working pressure test	40	11-02
Removal-Installation - Dual Command (2 Speed Power Shift) control valve	41÷44	11-02
Disassembly-Assembly - Dual Command (2 Speed Power Shift) control valve	45-46	11-02

CHAPTER 5 - Reverser and creeper unit

Data	2	11-02
Tightening torque	3	11-02
Tools	4	11-02
Cross-sectional views	5÷7-15	11-02
Description and Operation	8	11-02
Fault diagnosis	8	11-02
Replacing clutch casing-reverser and creeper unit	9÷13	11-02

CHAPTER 6 - Power Shuttle transmission with Dual Command (2 Speed Power Shift) function

Data	2-3	11-02
Tightening torque	4-5	11-02
Tools	6	11-02
Cross-sectional views	8÷10	11-02
Description and Operation	11÷17	11-02
Disassembly-Assembly - clutch casing with power shuttle and Dual Command (2 Speed Power Shift)	18÷24	11-02
Disassembly-Assembly - clutch (A)	25-26	11-02
Disassembly-Assembly - clutch (B)	27	11-02
Fault code decoding	28	11-02
Calibrations	29÷47	11-02
First start-up procedure	48	11-02

	Page	Date
Diagnostics	49÷151	11-02

23 - DRIVE LINES

Data	2	11-02
Tightening Torques	3	11-02
Tools	3	11-02
Cross-sectional views	4	11-02
Description and Operation	5	11-02
Fault diagnosis	6	11-02
Removal-Installation - services control valve	7÷9	11-02
Disassembly-Assembly - services control valve	10÷11	11-02
Removal-Installation - drive gear casing	12÷16	11-02
Disassembly-Assembly - drive gear casing	17÷20	11-02

25 - FRONT MECHANICAL TRANSMISSION

Data	2÷4	11-02
Tightening Torques	4-5	11-02
Tools	6÷8	11-02
Cross-sectional views	9÷13	11-02
Description and Operation	12-14-15	11-02
Fault diagnosis	16	11-02
Removal-Installation - front axle	17÷20	11-02
Disassembly-Assembly - front axle	21÷29	11-02
Overhaul - front differential	30	11-02
Overhaul - front axle differential with LIM-SLIP	31-32	11-02
Overhaul - differential lock unit	33-34	11-02
Disassembly-Assembly - front epicyclic final drive without brake	35÷37	11-02
Replacing wheel hub seal without brake.	38	11-02
Disassembly-Assembly - front epicyclic final drive with brake	39-40	11-02
Replacing wheel hub seal with brake.	41	11-02
Replacing steering knuckle pins and bearings	42	11-02
Stub axle adjustments	43-44	11-02
Adjustments - bevel drive	45÷51	11-02

	Page	Date

27 - REAR MECHANICAL TRANSMISSION

Data	2-3	11-02
Tightening Torques	3-4	11-02
Tools	5÷9	11-02
Cross-sectional views	10÷14	11-02
Description and Operation	15	11-02
Fault diagnosis	16-17	11-02
Removal-Installation - transmission-gearbox casing	18÷38	11-02
Disassembly-Assembly - transmission-gearbox casing	39÷46	11-02
Gearbox driving shaft end float adjustment	47	11-02
Adjustments - differential lock engagement sleeve position	48	11-02
Adjustments - bevel drive	49÷57	11-02
Adjustments - differential lock control pedal travel	58	11-02
Removal-Installation - side gear casing	59÷62	11-02
Disassembly-Assembly - epicyclic final drive	62	11-02
Disassembly-Assembly - drive wheel shaft	63-64	11-02

31 - POWER TAKE-OFF

CHAPTER 1 - Mechanical power take-off

Data	2÷4	11-02
Tools	5	11-02
Tightening Torques	6	11-02
Cross-sectional views	7÷9	11-02
Description and Operation	10-11	11-02
Fault diagnosis	11	11-02
Removal-Installation - power take-off	12÷14	11-02
Disassembly-Assembly - power take-off	15÷17	11-02

CHAPTER 2 - Electro-hydraulic power take-off

Data	2÷5	11-02
Tools	5	11-02
Tightening Torques	6	11-02

	Page	Date
Cross-sectional views ...	7÷12	11-02
Description and Operation	13÷23	11-02
Fault diagnosis	24	11-02
Replacing the power take-off brake	25-26	11-02
Removal-Installation - power take-off	27÷30	11-02
Disassembly-Assembly - power take-off	31÷37	11-02

33 - BRAKES

Data	1	11-02
Tightening Torques	2	11-02
Cross-sectional views ...	3-4	11-02
Tools	4-5	11-02
Description and Operation	4	11-02
Hydraulic diagram - brakes	5	11-02
Pilot valve operation	6	11-02
Fault diagnosis	7	11-02
Adjustments - parking handbrake travel	8	11-02
Removal-Installation/Disassembly-Assembly parking brake casing	9÷11	11-02
Service brake circuit air bleeding	12	11-02
Removal-Installation - service brake pump	13-14	11-02
Adjusting the height of the service brake pedals	14	11-02
Removal-Installation - service brake	15÷19	11-02

35 - HYDRAULIC SYSTEMS

CHAPTER 1 - Rear mechanical hydraulic lift

Data	2÷6	11-02
Tightening Torques	7-8	11-02
Tools	9	11-02
Cross-sectional views ...	10-11	11-02
Description and Operation	12÷15	11-02
Fault diagnosis	16-17	11-02
Disassembly-Assembly - oil pump	18-19	11-02
Disassembly-Assembly - LIFT-O-MATIC control .	20	11-02
Adjustments - lift rod mechanism	21÷23	11-02
Disassembly-Assembly - external lift controls	24	11-02
Removal-Installation - lift .	25÷31	11-02
Disassembly-Assembly - lift	32÷36	11-02
Adjusting the lift	37÷42	11-02
Removal-Installation - lift control valve	43-44	11-02
Disassembly-Assembly - lift control valve	45÷49	11-02
Lift pressure relief valve ..	50	11-02

CHAPTER 2 - Open centre system auxiliary control valves

Data	1	11-02
Tools	1	11-02
Tightening Torques	2	11-02
Cross-sectional views ...	3÷5	11-02
Description and Operation	6÷9	11-02
Disassembly-Assembly - auxiliary control valves .	10-11	11-02
Rod hardening test	11	11-02
Blow-by test	12	11-02
Adjustment of the automatic detent release pressure	12	11-02
Removal-Installation - flow control valve	13	11-02
Adjustments - flow control valve	14-15	11-02

CHAPTER 3 - Auxiliary control valves (BOSCH)

Data	2	11-02
Tools	2	11-02
Tightening Torques	3	11-02
View of BOSCH auxiliary control valve components .	4-6÷9	11-02
Description and Operation	4-5-10÷18	11-02
Removal-Installation - BOSCH auxiliary control valves	19÷21	11-02
Disassembly-Assembly - BOSCH auxiliary control valves	22÷26	11-02

CHAPTER 4 - Trailer brake auxiliary control valve

Cross-sectional views ...	1	11-02
Description and Operation	9	11-02

	Page	Date
Fault diagnosis	10÷12	11-02
CHAPTER 5 - Supplementary Cylinder		
Data	1	11-02
Cross-sectional views	1	11-02
Description and Operation	1	11-02
Removal-Installation/Disassembly-Assembly - supplementary cylinder	2	11-02
CHAPTER 6 - Electronic Lift		
Data	2-3	11-02
Tightening Torques	4	11-02
Tools	4	11-02
View of electronic lift components	5	11-02
Electronic lift control layout	6-7	11-02
Description and Operation	8÷11	11-02
Fault code decoding	12	11-02
Diagnostics	13÷46	11-02
Lift electronic control unit	47	11-02
Electronic lift control panel	48	11-02
Lift arm potentiometer replacement	49	11-02
Removal -Installation - draft sensor	50-51	11-02
Electronic lift calibration	52-53	11-02
Removal-Installation - electronic lift	54÷59	11-02
Removal-Installation - hydraulic control valve	60-61	11-02
41 - STEERING		
Data	2÷4	11-02
Tightening Torques	4	11-02
View of hydraulic pump components	5	11-02
View of hydrostatic steering control valve components	6	11-02
Description and Operation	7÷10	11-02
Fault diagnosis	11-12	11-02
Tools	12	11-02
Removal-Installation - hydrostatic steering control valve	13÷18	11-02
Disassembly-Assembly - hydrostatic control valve	19÷32	11-02
Hydrostatic steering control valve bench testing	33-34	11-02
Pressure relief valve testing	34	11-02
Disassembly-Assembly - hydraulic pump	35-36	11-02
Removal-Installation - steering cylinder	37-38	11-02
44 - AXLES AND WHEELS		
Data	1-2	11-02
Front wheel track diagram	2	11-02
Cross-sectional views	3	11-02
Tightening Torques	4-5	11-02
Tools	5	11-02
Fault diagnosis	5	11-02
Disassembly-Assembly - wheel axle hub	6÷8	11-02
Removal-Installation - front axle	9÷11	11-02
Stub axle hub overhaul	12÷14	11-02
Checking leading wheels alignment	15-16	11-02
50 - SUBSIDIARY PARTS		
Safety regulations	2	11-02
Main specifications	3-4	11-02
Tools	4	11-02
Operating principles	5-6	11-02
Components of cab air conditioning system	7÷11	11-02
Cab controls	12÷14	11-02
Instructions for use - air conditioning system	15	11-02
Air-conditioning system filling and evacuation recovery/recycling station	15	11-02
Leak detector	16	11-02
Conditioning system maintenance	17	11-02
Troubleshooting	18	11-02
Fault diagnosis	19÷22	11-02
System functional testing	23	11-02
Checking for and eliminating gas leaks	24	11-02
Compressor drive belt tension adjustment	25	11-02
Removal-Installation - compressor	26-27	11-02
Heating and air conditioning systems piping replacement	28÷35	11-02
Condenser replacement	36	11-02
Dryer filter replacement	37-38	11-02
Removal-Installation - heater unit	39÷41	11-02

	Page	Date
Replacing the air-conditioner evaporator	42÷44	11-02
Removal-Installation - electric fan	45-46	11-02

55 - ELECTRICAL SYSTEM

CHAPTER 1 - Instruments

Analog instruments	1÷3	11-02
Transmitters, sensors and switches	4÷11	11-02
Maintenance	8÷12	11-02
Electronic instruments	13÷16	11-02
Diagnostics	17÷22	11-02

CHAPTER 2 - Components

Introduction	1	11-02
Components	2÷14	11-02
Maintenance	15-16	11-02

CHAPTER 3 - Starting system

Technical data	1	11-02
Tightening Torques	1	11-02
Description and Operation	2	11-02
Wiring diagram	3	11-02
Fault diagnosis	4	11-02
System testing	5÷7	11-02
Removal-Installation - overhaul	7÷9	11-02
Starter motor testing	10-11	11-02

CHAPTER 4 - Charging system

Technical data	1	11-02
Tightening Torques	1	11-02
Description and Operation	2-3	11-02
System testing	4÷9	11-02
Removal-Installation and Overhaul - alternator	10÷18	11-02

CHAPTER 5 - Battery

Technical data	1	11-02
Description and Operation	1	11-02
Removal-Installation - battery	2-3	11-02
Battery maintenance	4	11-02
Battery charging	5-6	11-02
Battery testing	6÷8	11-02

	Page	Date

CHAPTER 6 - Electrical circuits

Electrical circuit components	3÷6	11-02
Location of fuses and relays	7÷15	11-02
Power sockets	16	11-02
Operator safety circuit	17	11-02
Ground location points	18-19	11-02
Symbols used in electrical circuits	20-21	11-02
Electrical circuits and wiring	22÷233	11-02

CHAPTER 7 - Components Testing

Switches - pressure switches - sensors	2÷16	11-02
Removal-Installation - windscreen wiper motor	17	11-02

90 - BODYWORK AND DRIVING POSITION

Removal-Installation - platform	2÷9	11-02
Removal-Installation - driver's seat	10	11-02
Removal-Installation - door	11	11-02
Replacement of glued cab windows	12-13	11-02
Replacement of cab rear window	14÷16	11-02
Replacement of seal on left-hand upright	17	11-02
Replacement of seal on right-hand upright	18÷21	11-02
Replacement of fixed padding on right-hand wall	22÷27	11-02
Replacement of fixed padding on left-hand wall	28-29	11-02
Replacing hydraulic control lever guard	30-31	11-02
Replacing cab ceiling fittings	32-33	11-02

INTRODUCTION

◊ *This manual is divided into sections identified by two-figure numbers and each section has independent page numbering.*
For easy reference, these sections have the same numbers and names as the Repairs Rate Book sections.

◊ *The different sections can easily be found by consulting the table of contents on the following pages.*

◊ *The document number of the manual and the edition/update dates are given at the bottom of each page.*

◊ *Pages updated in the future will be identified by the same document number followed by a two-figure update number (e.g., 1st Update 603.54.420.01; 2nd Update 603.54.420.02; etc.) and by the corresponding issue date.*
These pages will be supplemented by a reprint of the updated contents page.

◊ *The information contained in this manual was current on the date printed on each section. As NEW HOLLAND constantly improves its product range, some information may be out of date subsequent to modifications implemented for technical or commercial reasons, or to meet legal requirements in different countries.*
In the event of conflicting information, consult the NEW HOLLAND Sales and Service Departments.

IMPORTANT WARNINGS

◊ *All maintenance and repair work described in this manual must be performed exclusively by NEW HOLLAND service technicians, in strict accordance with the instructions given and using any specific tools necessary.*

◊ *Anyone performing the operations described herein without strictly following the instructions is personally responsible for any eventual injury or damage to property.*

◊ *The Manufacturer and all organisations belonging to the Manufacturer's distribution network, including but not restricted to national, regional or local distributors, will accept no responsibility for personal injury or damage to property caused by abnormal function of parts and/or components not approved by the Manufacturer, including those used for maintenance and/or repair of the product manufactured or marketed by the Manufacturer.*
In any case, the product manufactured or marketed by the Manufacturer is covered by no guarantee of any kind against personal injury or damage to property caused by abnormal function of parts and/or components not approved by the Manufacturer.

TEXT AND ILLUSTRATIONS ARE THE PROPERTY
OF CNH ITALIA S.p.A.

●

No part of the text or illustrations
may be reproduced

PRINTED IN ITALY

CNH ITALIA S.p.A. - Viale delle Nazioni, 55 - 41100 MODENA - Italy
Product Support - Technical Information
Print No. **603.54.421.00** - 11 - 2002 - 300

GENERAL INSTRUCTIONS

IMPORTANT NOTICE

All maintenance and repair work described in this manual must be performed exclusively by NEW HOLLAND service technicians, in strict accordance with the instructions given and using any specific tools necessary.

Anyone performing the operations described herein without strictly following the instructions is personally responsible for any eventual injury or damage to property.

SHIMMING

For each adjustment operation, select adjusting shims and measure individually using a micrometer, then add up the recorded values. Do not rely on measuring the entire shimming set, which may be incorrect, or the rated value indicated for each shim.

ROTATING SHAFT SEALS

For correct rotating shaft seal installation, proceed as follows:

- before assembly, allow the seal to soak in the oil it will be sealing for at least thirty minutes;
- thoroughly clean the shaft and check that the working surface on the shaft is not damaged;
- position the sealing lip facing the fluid; with hydrodynamic lips, take into consideration the shaft rotation direction and position the grooves so that they will deviate the fluid towards the inner side of the seal;
- coat the sealing lip with a thin layer of lubricant (use oil rather than grease) and fill the gap between the sealing lip and the dust lip on double lip seals with grease;
- insert the seal in its seat and press down using a flat punch; do not tap the seal with a hammer or mallet;
- whilst inserting the seal, check that it is perpendicular to the seat; once settled, make sure that it makes contact with the thrust element, if required;
- to prevent damaging the seal lip on the shaft, position a protective guard during installation operations.

"O-RING" SEALS

Lubricate the O-RING seals before inserting them in the seats, this will prevent them from overturning and twisting, which would jeopardise sealing efficiency.

SEALING COMPOUNDS

Apply one of the following sealing compounds on the mating surfaces marked with an X: RTV SILMATE, RHODORSIL CAF 1 or LOCTITE PLASTIC GASKET.

Before applying the sealing compound, prepare the surfaces as follows:

- remove any incrustations using a wire brush;
- thoroughly de-grease the surfaces using one of the following cleaning agents: trichlorethylene, petrol or a water and soda solution.

BEARINGS

When installing bearings it is advised to:

- heat the bearings to 80 ÷ 90 °C before fitting on the shafts;
- allow the bearings to cool before installing them.

SPRING PINS

When fitting split socket spring pins, ensure that the pin notch is positioned in the direction of the force required to stress the pin.

Spiral spring pins do not require special positioning.

SPARE PARTS

Use solely **genuine parts**, which guarantee the same quality, duration and safety as the original parts as they are identical to the ones fitted during production.

Only **genuine parts** can offer this guarantee.

When ordering spare parts, always provide the following information:

- tractor model (commercial name) and frame number;
- engine type and number;
- part number of the ordered part, which can be found in the “Microfiches” or the “Spare Parts Catalogue”, used for order processing.

TOOLS

The tools that NEW HOLLAND offer and illustrate in this manual are:

- specifically researched and designed for use with NEW HOLLAND vehicles;
- essential for reliable repair operations;
- accurately built and rigorously tested so as to offer efficient and long-lasting operation.

By using these tools, repair personnel will benefit from:

- operating in optimal technical conditions;
- obtaining the best results;
- saving time and effort;
- working in safe conditions.

IMPORTANT NOTES

Wear limit values indicated for certain parts are recommended, but not binding. The terms “front”, “rear”, “right-hand” and “left-hand” (when referred to different parts) are intended as seen from the driving position with the vehicle in the normal direction of movement.

MOVING THE TRACTOR WITH THE BATTERY REMOVED

External power supply cables should only be connected to the respective positive and negative cable terminals, using efficient clamps that guarantee adequate and secure contact.

Disconnect all services (lights, windshield wipers, etc.) before starting the vehicle.

If the vehicle electrical system requires checking, carry out operations with the power supply connected. Once checking is completed, disconnect all services and switch off the power supply before disconnecting the cables.

SAFETY REGULATIONS

PAY ATTENTION TO THIS SYMBOL

This warning symbol points out important messages concerning your safety.

Carefully read the following safety regulations and observe advised precautions in order to avoid potential hazards and safeguard your health and safety.

In this manual the symbol is accompanied by the following key-words:

***CAUTION** - Warnings concerning unsuitable repair operations that may jeopardise the safety of Service personnel.*

***DANGER** - Specific warnings concerning potential hazards for operator safety or for other persons directly or indirectly involved.*

ACCIDENT PREVENTION

Most accidents or injuries that occur in workshops are the result of non-observance of simple and fundamental safety regulations.

For this reason, IN MOST CASES THESE ACCIDENTS CAN BE AVOIDED by foreseeing possible causes and consequently acting with the necessary caution and care.

Accidents may occur with all types of vehicle, regardless of how well it was designed and built.

A careful and judicious service technician is the best guarantee against accidents.

Precise observance of the most basic safety rule is normally sufficient to avoid many serious accidents.

DANGER. Never carry out any cleaning, lubrication or maintenance operations when the engine is running.

SAFETY REGULATIONS

GENERAL GUIDELINES

- Carefully follow specified repair and maintenance procedures.
- Do not wear rings, wristwatches, jewellery, unbuttoned or loose articles of clothing such as: ties, torn clothing, scarves, open jackets or shirts with open zips that may remain entangled in moving parts.

  It is advised to wear approved safety clothing, e.g.: non-slip footwear, gloves, safety goggles, helmets, etc.
- Do not carry out repair operations with someone sitting in the driver's seat, unless the person is a trained technician who is assisting with the operation in question.
- Operate the vehicle and use the implements exclusively from the driver's seat.
- Do not carry out operations on the vehicle with the engine running, unless specifically indicated.
- Stop the engine and check that the hydraulic circuits are pressure-free before removing caps, covers, valves, etc.
- All repair and maintenance operations must be carried out using extreme care and attention.
- Service steps and platforms used in a workshop or in the field should be built in compliance with the safety rules in force.
- Disconnect the batteries and label all controls to indicate that the vehicle is being serviced. Any parts that are to be raised must be locked in position.
- Do not check or fill fuel tanks, accumulator batteries, nor use starting liquid when smoking or near naked flames, as these fluids are inflammable.
- Brakes are inoperative if manually released for repair or maintenance purposes.

  Use blocks or similar devices to secure the machine in these conditions.
- The fuel nozzle should always be in contact with the filling aperture. Maintain this position until filling operations are completed in order to avoid possible sparks caused by the accumulation of static electricity.

- Only use specified towing points for towing the tractor, connect parts carefully. Make sure that all pins and/or locks are secured in position before applying traction.

  Never remain near the towing bars, cables or chains that are operating under load.

- Transport vehicles that cannot be driven using a trailer or a low-loading platform trolley, if available.

- When loading or unloading the vehicle from the trailer (or other means of transport), select a flat area capable of sustaining the trailer or truck wheels, firmly secure the tractor to the truck or trailer and lock the wheels in the position.

- Electric heaters, battery-chargers and similar equipment must only be powered by auxiliary power supplies with efficient ground insulation to avoid electrical shock hazards.

- Always use suitable hoisting or lifting devices when raising or moving heavy parts.

- Take extra care if bystanders are present.

- Never pour gasoline or diesel oil into open, wide and low containers.

- Never use gasoline, diesel oil or other inflammable liquids as cleaning agents. Use non-inflammable, non toxic commercially available solvents.

- Wear safety goggles with side guards when cleaning parts with compressed air.

- Limit the air pressure to a maximum of 2.1 bar, according to local regulations.

- Do not run the engine in confined spaces without suitable ventilation.

- Do not smoke, use naked flames, or cause sparks in the area when fuel filling or handling highly inflammable liquids.

- Never use naked flames for lighting when working on the machine or checking for “leaks.”

- All movements must be carried out carefully when working under, on or near the vehicle and wear protective equipment: helmets, goggles and special footwear.

- When carrying out checks with the engine running, request the assistance of an operator in the driver’s seat. The operator must maintain visual contact with the service technician at all times.

- If operating outside the workshop, position the vehicle on a flat surface and lock in position. If working on a slope, lock the vehicle in position and move to a flat area as soon as is safely possible.

- Damaged or bent chains or cables are unreliable. Do not use them for lifting or towing.

  Always use suitable protective gloves when handling chains or cables.

- Chains should always be safely secured. Make sure that the hitch-up point is capable of sustaining the load in question.

  Keep the area near the hitch-up point, chains or cables free of all bystanders.

- Maintenance and repair operations must be carried out in a CLEAN and DRY area, eliminate any water or oil spillage immediately.

- Do not create piles of oil or grease-soaked rags as they represent a serious fire hazard; store them in a closed metal container.

  Before starting the vehicle or implements, make sure that the driver’s seat is locked in position and always check that the area is free of persons or obstacles.

- Empty pockets of all objects that may fall unobserved into the vehicle parts when disassembled.

- In the presence of protruding metal parts, use protective goggles or goggles with side guards, helmets, special footwear and gloves.

- When welding, use protective safety devices: tinted safety goggles, helmets, special overalls, gloves and footwear. All persons present in the area where welding is taking place must wear tinted goggles.

  NEVER LOOK DIRECTLY AT THE WELDING ARC WITHOUT SUITABLE EYE PROTECTION.

- Metal cables tend to fray with repeated use. Always use suitable protective devices (gloves, goggles, etc.) when handling cables.

- Handle all parts carefully, do not put your hands or fingers between moving parts, wear suitable safety clothing - safety goggles, gloves and shoes.

START UP

- Never start the engine in confined spaces that are not equipped with adequate ventilation for exhaust gas extraction.
- Never bring your head, body, arms, legs, feet, hands, fingers near fans or rotating belts.

ENGINE

- Always loosen the radiator cap slowly before removing it to allow any remaining pressure in the system to be discharged. Coolant should only be added when the engine is stopped or idling, if hot.
- Never fill up with fuel when the engine is running, especially if hot, in order to prevent the outbreak of fire as a result of fuel spillage.
- Never check or adjust fan belt tension when the engine is running.

  Never adjust the fuel injection pump when the vehicle is moving.
- Never lubricate the vehicle when the engine is running.

ELECTRICAL SYSTEMS

- If it is necessary to use auxiliary batteries, remember that both ends of the cables must be connected as follows: (+) with (+) and (–) with (–).
- Avoid short-circuiting the terminals. GAS RELEASED FROM BATTERIES IS HIGHLY INFLAMMABLE.
- During charging, leave the battery compartment uncovered to improve ventilation.
- Never check the battery charge using “jumpers” (metal objects placed on the terminals).
- Avoid sparks or flames near the battery zone to prevent explosion hazards.
- Before servicing operations, check for fuel or current leaks. Eliminate any eventual leaks before starting work.
- Never charge batteries in confined spaces. Make sure that there is adequate ventilation in order to prevent accidental explosion hazards as a result of the accumulation of gases released during charging operations.
- Always disconnect the battery before performing any kind of servicing on the electrical system.

HYDRAULIC SYSTEMS

- A liquid leaking from a tiny hole may be almost invisible but, at the same time, be powerful enough to penetrate the skin. Check for leaks using a piece of cardboard, **NEVER USE HANDS**.
- If any liquid penetrates skin tissue, call for medical aid immediately.
- Serious skin infections may result if medical attention is not given.
- Use the specific tools when checking pressure values on the hydraulic system.

WHEELS AND TYRES

- Check that the tyres are correctly inflated at the pressure specified by the manufacturer.

  Periodically check possible damages to the rims and tyres.
- Stand away from (at the side of) the tyre when checking inflation pressure.
- Only check pressure when the tractor is unloaded and the tyres are cold, to avoid incorrect readings as a result of over-pressure.
- Do not re-use parts of recovered wheels as incorrect welding or brazing may heat the material, causing it to weaken and eventually damage or break the wheel.
- Never cut or weld a rim mounted with an inflated tyre.
- When removing the wheels, lock both the front and rear vehicle wheels.
- Always position support stands when raising the vehicle, in order to conform to current safety regulations.
- Deflate the tyre before removing any object caught in the tyre tread.
- Never inflate tyres using inflammable gases; this could cause an explosion and put operator safety at risk.

REMOVAL AND INSTALLATION

- Lift and handle all heavy parts using suitable lifting equipment and make sure that all slings and hooks are correctly secured.
- Handle all parts carefully during lifting operations, keep an eye on the personnel working near the load to be lifted. Never insert hands or fingers between parts, always wear approved accident prevention clothing (goggles, gloves and work boots).
- Avoid twisting chains or metal cables and always wear safety gloves when handling cables or chains.

CONSUMABLES

COMPONENT TO BE FILLED OR TOPPED UP	QUANTITY dm^3 US Gallon (litres)	RECOMMENDED NEW HOLLAND PRODUCT	NEW HOLLAND SPECIFICATIONS	INTERNATIONAL SPECIFICATIONS
Cooling system: without cab: . . . . . . with cab:	3.69 (14) 4.22 (16)	Water and **AMBRA AGRIFLU** fluid 50% + 50%	NH 900 A	-
Windscreen washer reservoir	0.52 (2)	Water and liquid detergent	-	-
Fuel tank models TL70, TL80 . . . . models TL90, TL100 . . .	30.37 (115) 35.66 (135)	Decanted and filtered diesel fuel	-	-
Engine sump: without filter: . . . . . . with filter:	2.35 (8.9) 2.50 (9.5)	**AMBRA SUPER GOLD 15W - 40** oil or **10W - 30**	NH 330G (SAE 15W-40) NH 324G (SAE 10W-30)	API CF-4/SG CCMC D4 MIL-L-2104E
Brake control circuit without front brakes	0.10 (0.4)	**AMBRA BRAKE LHM fluid**	NH 610 A	ISO 7308
Hydrostatic steering circuit . .	0.52 (2.0)	**AMBRA MULTI G oil**	NH 410 B	API GL4 ISO 32/46 SAE 10W-30
Front axle: axle casing: model TL70 . . . . . . models TL80, TL90, TL100 final drives (each): model TL70 . . . . . . models TL80, TL90, TL100	 1.18 (4.5) 1.84 (7.0) 0.21 (0.8) 0.33 (1.25)			
Rear transmission (bevel drive, final drives and brakes), gearbox, hydraulic lift, PTO and hydraulic steering: model TL70 . . . . . . models TL80, TL90, TL100	 12.94 (49) 14.52 (55)			
Front wheel hubs	-	**AMBRA GR9 grease**	NH 710 A	NLGI 2
Grease fittings	-			

SECTION 10 - ENGINE

Chapter 1 - Engine

CONTENTS

Operation	Description	Page
	General specifications	2
	Data	5
	Tightening Torques	22
	Tools	23
	Cross-sectional views	25
	Lubrication diagram	27
	Cooling system diagram	28
	Fault diagnosis	29
10 001 10	Engine R.I.	33
10 001 30	Engine. Compression Test	48
10 001 53	Engine D.A. Checks, dimensions and repairs	49
10 101 53	Valve guides - Replacement	90
10 101 60	Injector sleeve - Replacement	94
10 102 70	Crankshaft front seal - Replacement	96
10 106 12	Valve tappet clearance - Adjustment	99
10 218 30	Engine injector R.I.	102
10 246 14	Bosch injection pump R.I. Timing. Air bleed	105
10 402 10	Coolant pump R.I.	113
10 402 28	Coolant pump D.A.	116
10 402 30	Thermostat valve R.I.	117
10 406 10	Radiator R.I.	121
10 414 10	Coolant pump and generator drive belts. Tension adjustment	125

GENERAL SPECIFICATIONS	4 cylinders
Engine, technical type:	
- model TL70 - type 8045.06R.412/414 (BOSCH pump) ...	See data on page 6
- model TL70 - type 8045.06R.513 (BOSCH pump)	See data on page 6
- model TL80 - type 8045.05R.412/414 (BOSCH pump) ...	See data on page 8
- model TL80 - type 8045.05R.512/513/518 (BOSCH pump)	See data on page 8
- model TL90 - type 8045.25.402/404 (BOSCH pump)	See data on page 10
- model TL90 - type 8045.25.502/503 (BOSCH pump)	See data on page 10
- model TL100 - type 8045.25K.413 (BOSCH pump)	See data on page 12
- model TL100 - type 8045.25K.513 (BOSCH pump)	See data on page 12
Cycle	diesel, 4-stroke
Direct	injection
Number of cylinders in line	4
Cylinder liners	dry force-fitted in cylinder block
Piston diameter	
- model TL70	3.94 inch (100 mm)
- model TL80	4.1 inch (104 mm)
- model TL90	4.1 inch (104 mm)
- model TL100	4.1 inch (104 mm)
Piston stroke	4.52 inch (115 mm)
Total displacement:	
- model TL70	3613 cm^3
- model TL80	3908 cm^3
- model TL90	3908 cm^3
- model TL100	3908 cm^3
Compression ratio for models TL70 and TL80	17:1 normally aspirated
Compression ratio for models TL90 and TL100	16.5:1 turbocharged
Maximum power:	
- model TL70	48 kW (65 Hp)
- model TL80	56 kW (75 Hp)
- model TL90	63 kW (85 Hp)
- model TL100	70 kW (95 Hp)
Maximum power speed	2500 rev/min
Maximum torque speed - model TL70	1400 rpm
Maximum torque speed - model TL80	1400 rpm
Maximum torque speed - model TL90	1500 rev/min
Maximum torque speed - model TL100	1500 rev/min
Number of main bearings	5
Sump pan	structural, cast iron

(continued)

(cont)

GENERAL SPECIFICATIONS	3 cylinders	4 cylinders
Lubrication	forced, with gear pump	
Pump drive	camshaft	
Engine speed/oil pump speed ratio	2:1	
Oil cleaning	mesh filter on oil intake and filtering cartridge on delivery line	
Normal oil pressure with motor warmed-up and running at maximum speed:		
For models TL70 and TL80	42.1 to 56.6 psi (2.9 to 3.9 bar)	
For model TL90 (start of work)	≥ 72.5 psi (≥ 5 bar)	
For model TL100 (start of work)	≥ 58 psi (≥ 4 bar)	
Pressure relief valve	incorporated in oil pump housing	
Valve initial opening pressure	50.7 psi (3.5 bar)	
For further lubrication technical data	See page 21	
Cooling system	coolant circulation	
Radiator on models TL70 and TL80	3 lines of vertical pipes with copper fins	
Radiator on models TL90 and TL100	4 lines of vertical copper pipes	
Fan, attached to coolant pump pulley	intake, 4-blade in sheet-metal	
Coolant pump	centrifugal vane-type	
Engine speed/coolant pump speed ratio	1:1,403	
Temperature control	thermostat	
Coolant thermometer	coloured scale divided into 3 sections	
Temperature ranges corresponding to each section:		
- initial white section	86° to 149 °F (30° to 65 °C)	
- middle green section (normal working conditions)	149° to 221 °F (65° to 105 °C)	
- final red section	221° to 239 °F (105° to 115 °C)	
For further cooling system technical data	See page 21	
Rev counter/hourmeter	incorporated in control panel	
Operating	from gear on camshaft	
Hour counter calibrated for engine speed of	1800 rev/min	

(continued)

(cont)

GENERAL SPECIFICATIONS	3 cylinders	4 cylinders
Timing	overhead valves operated by tappets, rods and rocker arms via the camshaft located in the engine block; the camshaft is driven by the crankshaft using helical gears	
Inlet:		
- start: before T.D.C.	12°	
- end: after B.D.C.	31°	
Exhaust:		
- start: before B.D.C.	50°	
- end: after T.D.C.	16°	
Valve-rocker arm clearance for timing check	0.02 inch (0.45 mm)	
Valve-rocker arm clearance (with engine cold):		
- inlet	0.02 ± 0.002 inch (0.30 ± 0.05 mm)	
- exhaust	0.02 ± 0.002 inch (0.30 ± 0.05 mm)	
For further timing system technical data	See page 18	
Fuel system		
Air cleaning	dual cartridge dry air filter, with clogged filter indicator with centrifugal pre-filter and automatic dust ejector	
Fuel pump	with double diaphragm	
Fuel filtering	through wire filter in fuel supply pump, and replaceable cartridge on delivery line to injection pump	
Minimum fuel flow rate with pump shaft rotating at 1600 rpm	100 litres/hour	
Cam operated	engine timing	
BOSCH injection pump	rotating distributor type	
All-speed governor, incorporated in pump:		
BOSCH	centrifugal counterweights	
Automatic advance regulator, incorporated in pump:		
BOSCH	hydraulic	
For further fuel system technical data:		
Fixed advance (pump setting for start of delivery before TDC) - Pressure setting - Injection order, and other information regarding the BOSCH pump	refer to the data for the relevant engine type in the table on page 2	

FUEL SYSTEM DATA

Turbocharger (models TL90 and TL100):	
- GARRETT type	TA 3118-0.82 A/R-57
Injection pump	rotating distributor with speed governor and advance regulator incorporated
BOSCH pump:	
- model TL70 (Page 6)	VE 4/11 F 1250 L 816 - 99472103
- model TL70 (Page 6)	VE 4/11 F 1250 L 816-1 - 500324958
- model TL80 (Page 8)	VE 4/11 F 1250 L 774 - 99472101
- model TL80 (Page 8)	VE 4/11 F 1250 L 788 - 500324961
- model TL90 (Page 10)	VE 4/11 F 1250 L 793 - 99475604
- model TL90 (Page 10)	VE 4/11 F 1250 L 793-1 - 500324967
- model TL100 (Page 12)	VE 4/11 F 1250 L 775 - 99475605
- model TL100 (Page 12)	VE 4/11 F 1250 L 786 - 500324968
Direction of rotation	anti-clockwise
Injection order	1-3-4-2 (For all models)

	TL70	TL80	TL90	TL100
Fuel injectors:				
BOSCH type	500317389	500307714	500307714	500307714
- Nozzle holder type	4791124 KBEL 83S35	4791124 KBEL 83S35	4791124 KBEL 83S35	4791124 KBEL 83S35
- Nozzle type	500317390 DLLA 132S1335	99469341 DLLA 132S1320	99469341 DLLA 132S1320	99469341 DLLA 132S1320
Number of nozzle holes	5	5	5	5
Nozzle hole diameter inch (mm)	0.008 (0.21)	0.009 (0.23)	0.009 (0.23)	0.009 (0.23)
Calibration pressure psi (bar)	3771 to 3945 (260 to 272)	3771 to 3945 (260 to 272)	3771 to 3945 (260 to 272)	3771 to 3945 (260 to 272)
Delivery lines for BOSCH pump				
- type	99441952	99441952	-	99449006
- Line dimension mm	0.2x0.07x21.26 (6x1.75x540)	0.2x0.07x21.26 (6x1.75x540)	0.2x0.07x20.87 (6x1.75x530)	0.2x0.07x20.87 (6x1.75x530)

MODEL TL70 - BOSCH INJECTION PUMP CALIBRATION DATA
TYPE VE 4/11 F 1250 L 816 AND TYPE VE 4/11 F 1250 L 816-1

ASSEMBLY DATA

Pump timing on engine: delivery start 6° ± 1° before T.D.C. of cylinder 1 on compression stroke.
Plunger pre-lift for pump timing on engine: 0.04 in. (1 mm) from B.D.C. (with tools **380000228** - **380000229**).
Cylinder No. 1 delivery line union on pump: marked with letter A.

ASSEMBLY DIMENSIONS

SYM-BOL	SVS (max)	KF	MS	ya	yb
inch (mm)	0.17 (4.30)	0.19 to 0.21 (5.00 to 5.40)	0.05 to 0.07 (1.40 to 1.80)	1.49 to 1.57 (37.9 to 39.9)	1.74 to 1.95 (44.2 to 49.6)

CALIBRATION TEST CONDITIONS

Test bench conforming to ISO 4008/1 .../2
Injectors conforming to ISO 7440-A61 - [(1.688.901.020 with calibrated pad ∅ 0.02 in. (0.6 mm)].

Injector pressure setting 2694 to 2538 psi (172 to 175 bar).

Fuel supply pressure: 0.35 ± 0.05 psi (5.07 ± 0.72 bar).

Pipes (conforming to ISO 4093.2): 0.24 x 0.08 x 33 in. (mm 6 x 2 x 840).

Graduate drain time: 30 sec.

Test liquid: ISO 4113 at a temperature of 113° ± 33.8 °F (45° ± 1°C) at outlet.

1. START OF DELIVERY

Plunger pre-lift from BDC: 0.007 ± 0.001 in. (0.2 ± 0.02 mm) (0.04)	Pump rotation (viewed from drive side): anti-clockwise	Injection order: 1-3-4-2

2. ADVANCE REGULATOR STROKE

rpm: 800	Advance stroke: 0.12 to 0.13 in. (3.0 to 3.4 mm)

3. FUEL SUPPLY PUMP PRESSURE

rpm: 800	Internal pressure: 59.4 to 68.17 psi (4.1 to 4.7 bar)

4. FULL LOAD DELIVERY

rpm: 750	Delivery per 1000 shots: cm^3 62 to 63	Spread: cm^3 - 4.0 (4.0)

5. SPREAD GOVERNOR AT IDLE SPEED

rpm: 350	Delivery per 1000 shots: cm^3 21 to 25	Spread: $cm^3 \leq 3.5$ (3.5)

6. SPREAD GOVERNOR AT MAXIMUM SPEED

rpm: 1350	Delivery per 1000 shots: cm^3 43 to 47	Spread: cm^3

7. DELIVERY AT STARTING SPEED

rpm: 100	Delivery per 1000 shots: cm^3 90 to 140

8. TRANSFER PRESSURE PROGRESSION

Rev/min	600	800	1250
Internal pressure psi (bar)	46.4 to 55.1 (3.2 to 3.8)	59.4 to 68.1 (4.1 to 4.7)	88.4 to 97.1 (6.1 to 6.7)

9. INJECTION ADVANCE PROGRESSION

Rev/min	600	800	1000	1250
Advance stroke in. (mm)	0.0472 to 0.0787 (1.2 to 2.0) 0.0354 to 0.0906 (0.9 to 2.3)	0.118 to 0.134 (3.0 to 3.4) 0.0984 to 0.154 (2.5 to 3.9)	0.189 to 0.220 (4.8 to 5.6) 0.177 to 0.232 (4.5 to 5.9)	0.213 to 0.244 (5.4 to 6.2) 0.201 to 0.244 (5.1 to 6.5)

10. BACKFLOW

Rev/min		500	1250
Backflow	cm^3	41.7 to 83.4 (26.7 to 98.4)	55.6 to 139 (40.6 to 153)

(continued)

NOTE: *The values shown above in brackets must be used for checking purposes only.*

(cont)

11. DELIVERY PROGRESSION

Rev/min	Delivery per 1000 shots: cm^3
1450	1.5 (0 to 3)
1400	8 to 18 (5 to 21)
1350	43 to 47 (39 to 51)
1250	52 to 55 (50 to 57)
750	62 to 63 (59.5 to 65.5)
500	57 to 61 (55.5 to 62.5)

12. DELIVERY CHECK AT IDLE SPEED

Rev/min	350	450
Delivery per 1000 shots: cm^3	21 to 25 (19 to 27)	0 to 3.0 (0 to 3)

NOTE: *The values shown above in brackets must be used for checking purposes only.*

13. ZERO CAPACITY (STOP)

Rev/min	Voltage (volts)	Delivery per 1000 shots: cm^3
1250	12	0 to 3

14. ZERO CAPACITY (STOP)

Rev/min	Voltage (volts)	Delivery per 1000 shots: cm^3
350	12	0 to 3

15. AUTOMATIC START SUPPLEMENT

Rev/min	Delivery per 1000 shots: cm^3
100	90 to 140
250	30 to 50
150	100 to 150

BENCH TEST PERFORMANCE DATA

Test conditions

Fixed advance before TDC. cylinder No. 1 in compression stroke: (see previous page)

Engine without fan, air filter and exhaust silencer.

Atmospheric pressure 29.13 ± 0.2 in. (740 ± 5 mm mercury).

Relative humidity 70% ± 5.

Ambient temperature 68 ± 37.4°F (20 ± 3°C).

Specific gravity of diesel fuel 830 ± 10 g/l at a temperature of 86 °F (30 °C).

Throttle lever position	Braking load applied	Engine Speed rev/min	Power output with engine run-in for a total of: Production running-in kW (Hp)	Power output with engine run-in for a total of: 50 hours (total) kW (Hp)	Fuel consumption kg/h
Maximum	For maximum power output	2500	≥ 46.3 (63)	47.8 to 49.6 (65 to 67.5)	11 to 11.4
Maximum	For maximum torque	1500	≥ 31.6 (43)	32.8 to 34.9 (44.6 to 47.6)	7.1 to 7.6
Maximum	None (no-load)	2750 to 2790	-	-	-
Minimum	None (no-load)	625 to 675	-	-	-

MODEL TL80 - BOSCH INJECTION PUMP CALIBRATION DATA
TYPE VE 4/11 F 1250 L 774 AND TYPE VE 4/11 F 1250 L 788

ASSEMBLY DATA

Pump timing on engine: delivery start 4° ± 0.5° before T.D.C. of cylinder 1 compression stroke.

Plunger pre-lift for pump timing on engine: 0.04 in. (1 mm) from B.D.C. (with tools **380000228** - **380000229**).

Cylinder No. 1 delivery line union on pump: marked with letter A.

ASSEMBLY DIMENSIONS

SYMBOL	SVS (max)	KF	MS	ya	yb
inch (mm)	0.181 (4.6)	0.209 to 0.224 (5.3 to 5.7)	0.055 to 0.070 (1.4 to 1.8)	1.49 to 1.57 (37.9 to 39.9)	1.73 to 1.74 (44 to 44.1)

CALIBRATION TEST CONDITIONS

Test bench conforming to ISO 4008/1 .../2

Injectors conforming to ISO 7440-A61 - [(1.688.901.027 with pad ∅ 0.02 in. (0.5 mm)].

Injector pressure setting 3582 to 3670 psi (247 to 253 bar).

Fuel supply pressure: 5.1 ± 0.7 psi 0.35 ± 0.05 bar.

Delivery pipes (conforming to ISO 4093.2): 0.2 x 0.07 x 17.7 in. (6 x 2 x 450 mm).

Graduate drain time: 30 sec.

Test liquid: ISO 4113 at a temperature of 111.2° ± 39.2 °F (44° ± 4 °C) at outlet.

1. START OF DELIVERY

Plunger pre-lift from BDC: 0.007 ± (0.2 ± 0.02 mm) (0.04)	Pump rotation (viewed from drive side): anti-clockwise	Injection order: 1-3-4-2

2. ADVANCE REGULATOR STROKE

rpm: 800	Advance stroke: 0.122 to 0.138 in. (3.1 to 3.5 mm)

3. FUEL SUPPLY PUMP PRESSURE

rpm: 800	Internal pressure: 68.1 to 76.8 psi (4.7 to 5.3 bar)

4. FULL LOAD DELIVERY

rpm: 750	Delivery per 1000 shots: cm^3 52.5 to 53.5	Spread: cm^3 - 3.5 (4.0)

5. SPREAD GOVERNOR AT IDLE SPEED

rpm: 350	Delivery per 1000 shots: cm^3 6 to 10	Spread: cm^3 ≤ 3.5 (3.5)

6. SPREAD GOVERNOR AT MAXIMUM SPEED

rpm: 1350	Delivery per 1000 shots: cm^3 37 to 41	Spread: cm^3

7. DELIVERY AT STARTING SPEED

rpm: 100	Delivery per 1000 shots: cm^3 65 to 115

8. TRANSFER PRESSURE PROGRESSION

Rev/min		800	500	1250
Internal pressure	psi (bar)	68.1 to 76.8 (4.7 to 5.3)	46.4 to 55.1 (3.2 to 3.8)	100 to 108.7 (6.9 to 7.5)

9. INJECTION ADVANCE PROGRESSION

Rev/min		800	500	1250
Advance stroke	inch. (mm)	0.122 to 0.138 (3.1 to 3.5)	0.007 to 0.039 (0 to 0.051) [0.2 to 1.0 (0 to 1.3)]	0.272 to 0.295 (0.256 to 0.311) [6.9 to 7.5 (6.5 to 7.9)]

10. BACKFLOW

Rev/min		400	1250
Backflow	cm^3	41.6 to 86.1 (26.6 to 101)	55 to 138 (40 to 153)

(continued)

NOTE: *The values shown above in brackets must be used for checking purposes only.*

(cont)

11. DELIVERY PROGRESSION

Rev/min	Delivery per 1000 shots: cm^3
1450	0 to 3
1400	5 to 21
1350	37 to 41
1250	50 to 54 (48.5 to 55.5)
750	52.5 to 53.5 (50 to 56)
400	48.5 to 51.5 (46.5 to 53.5)

12. DELIVERY CHECK AT IDLE SPEED

Rev/min	350	450
Delivery per 1000 shots: cm^3	6 to 10 (4 to 12)	0 to 3.0

NOTE: *The values shown above in brackets must be used for checking purposes only.*

13. ZERO CAPACITY (STOP)

Rev/min	Voltage (volts)	Delivery per 1000 shots: cm^3
1250	12	0 to 3

14. ZERO CAPACITY (STOP)

Rev/min	Voltage (volts)	Delivery per 1000 shots: cm^3
350	12	0 to 3

15. AUTOMATIC START SUPPLEMENT

Rev/min	Delivery per 1000 shots: cm^3
100	65 to 115
250	40 to 60
150	75 to 125

BENCH TEST PERFORMANCE DATA

Test conditions

Fixed advance before TDC cylinder No. 1 in compression stroke: (see previous page)

Engine without fan, air filter and exhaust silencer.

Atmospheric pressure 29.13 ± 0.2 in. (740 ± 5 mm) mercury.

Relative humidity 70% ± 5.

Ambient temperature 77 °F (25 °C).

Specific gravity of diesel fuel 830 ± 10 g/l.

Throttle lever position	Braking load applied	Engine speed rev/min	Power output with engine run-in for a total of:		Fuel consumption kg/h
			Production running-in kW (Hp)	50 hours (total) kW (Hp)	
Maximum	For maximum power output	2500	≥ 52.6 (71.5) (*)	54.5 to 56.5 (74 to 77)	12.6 to 13.1
Maximum	For maximum torque	1500	≥ 36.4 (49.5) (*)	37.5 to 39.7 (51 to 54)	8.15 to 8.65
Maximum	None (no-load)	2750 to 2790	-	-	-
Minimum	None (no-load)	625 to 675	-	-	-

Programmed values (*).

MODEL TL90 - BOSCH INJECTION PUMP CALIBRATION DATA TYPE VE 4/11 F 1250 L 793 AND TYPE VE 4/11 F 1250 L 793-1

ASSEMBLY DATA

Pump timing on engine: delivery start 7° ± 0.5° before TDC of cylinder 1 on compression stroke.

Plunger pre-lift for pump timing on engine: 0.04 in. (1 mm) from BDC (with tools **380000228** - **380000229**).

Cylinder No. 1 delivery line union on pump: marked with letter A.

ASSEMBLY DIMENSIONS

SYMBOL	K	KF	MS	SVS (max)	ya	yb
inch (mm)	0.126 to 0.134 (3.2 to 3.4)	0.209 (5.30)	0.023 to 0.039 (0.6 to 1.0)	0.236 (6.0)	1.44 to 1.52 (36.5 to 38.5)	1.73 to 1.93 (43.9 to 49.1)

CALIBRATION TEST CONDITIONS

Test bench conforming to ISO 4008/1 .../2

Injectors conforming to ISO 7440-A61 - [(1.688.901.027 with pad ∅ 0.02 in. (0.5 mm)].

Injector pressure setting 3626 to 3670 psi (250 to 253 bar).

Fuel supply pressure: 5.1 ± 0.7 psi (0.35 ± 0.05 bar).

Delivery pipes (conforming to ISO 4093.2):

0.2 x 0.07 x 17.7 in. (6 x 2 x 450 mm).

Graduate drain time: 30 sec.

Test liquid: ISO 4113 at a temperature of 111.2° ± 4 °F (44° ± 4 °C) at outlet.

1. START OF DELIVERY

Plunger pre-lift from BDC: mm 0	Pump rotation (viewed from drive side): anti-clockwise	Injection order: 1-3-4-2

2. ADVANCE REGULATOR STROKE

rpm: 800	LDA pressure: kPa -	Advance stroke: 0.098 to 0.114 in. (2.5 to 2.9 mm)

3. FUEL SUPPLY PUMP PRESSURE

rpm: 800	LDA pressure: kPa -	Internal pressure: 82.6 to 91.3 psi (5.7 to 6.3 bar)

4. FULL-LOAD DELIVERY WITH BOOSTER PRESSURE

Rev/min: -	LDA pressure: kPa -	Delivery per 1000 shots: cm^3 -	Spread: cm^3 -

5. FULL-LOAD DELIVERY WITHOUT BOOSTER PRESSURE

rpm: 800	Delivery per 1000 shots: cm^3 67 to 68	Spread: cm^3 ≤ 3.5 (5.0)

6. SPREAD GOVERNOR AT IDLE SPEED

rpm: 325	LDA pressure: kPa -	Delivery per 1000 shots: cm^3 11 to 15	Spread: cm^3 ≤ 3.5 (5.0)

7. SPREAD GOVERNOR AT MAXIMUM SPEED

rpm: 1325	LDA pressure: kPa -	Delivery per 1000 shots: cm^3 43 to 47	Spread: cm^3 -

8. DELIVERY AT STARTING SPEED

rpm: 100	Delivery per 1000 shots: cm^3 65 to 115

9. TRANSFER PRESSURE PROGRESSION

LDA pressure: kPa	-		
Rev/min	400	800	1250
Internal pressure supply: psi (bar)	(3.7 to 4.3	5.7 to 6.3	7.7 to 8.3

10. INJECTION ADVANCE PROGRESSION

LDA pressure kPa	-		
Rev/min	700	800	1150
Advance stroke mm	1.76 to 1.84 (1.1 to 2.5)	2.5 to 2.9 (2.3 to 3.1)	6.0 to 6.8 (5.7 to 7.1)

11. BACKFLOW

Rev/min		400	1250
LDA pressure: kPa		-	-
Backflow for 10 s	cm^3	41.6 to 86.1 (26.6 to101)	55 to 138 (40 to 153)

(continued)

NOTE: *The values shown above in brackets must be used for checking purposes only.*

(cont)

12. DELIVERY PROGRESSION

Rev/min	Pressure LDA kPa	Delivery per 1000 shots: cm^3
1420	-	0 to 3
1325	-	43 to 47 (39 to 51)
1300	-	53.5 to 57.5 (50.5 to 60.5)
1250	-	58 to 61 (55.5 to 63.5)
800	-	67 to 68 (65 to 70)
400	-	67.5 to 70.5 (66.5 to 71.5)

13. DELIVERY CHECK AT IDLE SPEED

Rev/min	325	400
Delivery per 1000 shots: cm^3	11 to 15 (8 to 18)	0 to 3.0

NOTE: *The values shown above in brackets must be used for checking purposes only.*

14. ZERO CAPACITY (STOP)

Rev/min	Voltage (volts)	Delivery per 1000 shots: cm^3
1250	12	0 to 3

15. ZERO CAPACITY (STOP)

Rev/min	Voltage (volts)	Delivery per 1000 shots: cm^3
325	12	0 to 3

16. AUTOMATIC START SUPPLEMENT

Rev/min	Pressure LDA kPa	Delivery per 1000 shots: cm^3
100	-	65 to 115
250	-	45 to 75
150	-	75 to 125

BENCH TEST PERFORMANCE DATA

Test conditions

Fixed advance before TDC cylinder No. 1 in compression stroke: (see previous page)

Engine without fan, air filter and exhaust silencer.

Atmospheric pressure 29.13 ± 0.2 in. (740 ± 5 mm) mercury.

Relative humidity 70% ± 5.

Ambient temperature 77 °F (25 °C).

Specific gravity of diesel fuel 830 ± 10 g/l.

Throttle lever position	Braking load applied	Engine Speed rev/min	Power output with engine run-in for a total of: Production running-in kW (CV)	Power output with engine run-in for a total of: 50 hours (total) kW (Hp)	Fuel consumption kg/h
Maximum	For maximum power output	2500	≥ 60.6 (82.5)	61.8 to 64 (84 to 87)	13.9 to 14.7
Maximum	For maximum torque	1500	≥ 43.5 (59.2)	44.4 to 48 (60.4 to 65.2)	9.4 to 10
Maximum	None (no-load)	2725 to 2775	-	-	-
Minimum	None (no-load)	625 to 675	-	-	-

MODEL TL100 - BOSCH INJECTION PUMP CALIBRATION DATA TYPE VE 4/11 F 1250 L 775 AND TYPE VE 4/11 F 1250 L 786

ASSEMBLY DATA

Pump timing on engine: delivery start 7° ± 0.5° before TDC of cylinder 1 on compression stroke.

Plunger pre-lift for pump timing on engine: 0.04 in. (1 mm) from B.D.C. (with tools **380000228** - **380000229**).

Cylinder No. 1 delivery line union on pump: marked with letter A.

ASSEMBLY DIMENSIONS

SYMBOL	K	MS	ya	yb
in. (mm)	0.126 to 0.134 (3.2 to 3.4)	0.035 to 0.051 (0.90 to 1.30)	1.37 to 1.45 (34.9 to 36.9)	1.86 to 2.07 (47.3 to 52.5)

CALIBRATION TEST CONDITIONS

Test bench conforming to ISO 4008/1 .../2
Injectors conforming to ISO 7440-A61 - [(1.688.901.027 with calibrated pad ∅ 0.002 in. (0.5 mm)].

Injector pressure setting 3626 to 3670 psi (250 to 253 bar).

Fuel supply pressure: 5.8 ± 0.72 psi (0.35 ± 0.05 bar).

Delivery pipes (conforming to ISO 4093.2): 0.2 x 0.07 x 17.7 in. (6 x 2 x 450 mm).

Graduate drain time: 30 sec.

Test liquid: ISO 4113 at a temperature of 113° ± 102.5 °F (45° ± 1 °C).

1. START OF DELIVERY

Plunger pre-lift from BDC: mm 0	Pump rotation (viewed from drive side): anti-clockwise	Injection order: 1-3-4-2

2. ADVANCE REGULATOR STROKE

rpm: 850	Advance stroke: 0.066 to 0.082 in. (1.7 to 2.1 mm)

3. FUEL SUPPLY PUMP PRESSURE

rpm: 850	Internal pressure: 91.4 to 100.1 psi (6.3 to 6.9 bar)

4. FULL-LOAD DELIVERY WITH BOOSTER PRESSURE

rpm: 750	LDA pressure: kPa 100	Delivery per 1000 shots: cm^3 74 to 75	Spread: $cm^3 \leq 3.5$ (4.0)

5. FULL-LOAD DELIVERY WITHOUT BOOSTER PRESSURE

rpm: 500	Delivery per 1000 shots: cm^3 63 to 64

6. SPREAD GOVERNOR AT IDLE SPEED

rpm: 335	Delivery per 1000 shots: cm^3 8 to 12	Spread: $cm^3 \leq 3.5$ (4.0)

7. SPREAD GOVERNOR AT MAXIMUM SPEED

rpm: 1360	LDA pressure: kPa 100	Delivery per 1000 shots: cm^3 17.5 to 27.5

8. DELIVERY AT STARTING SPEED

rpm: 100	Delivery per 1000 shots: cm^3 80 to 120

9. TRANSFER PRESSURE PROGRESSION

LDA pressure kPa	100		
Rev/min	850	1050	1200
Internal pressure supply: psi (bar)	91.4 to 100.1 (6.3 to 6.9)	107.3 to 116 (7.4 to 8.0)	119 to 127.6 (8.2 to 8.8)

10. INJECTION ADVANCE PROGRESSION

LDA pressure	kPa	100		
Rev/min		850	1050	1200
Advance stroke	in. (mm)	0.066 to 0.082 (0.047 to 0.102) [1.7 to 2.1 (1.2 to 2.6)]	0.130 to 0.161 (3.3 to 4.1)	0.173 to 0.205 (0.161 to 0.217) [4.4 to 5.2 (4.1 to 5.5)]

11. BACKFLOW

Rev/min	350	1250
LDA pressure kPa	100	100
Backflow cm^3	46.9 to 85.5 (31.9 to 70.5)	55 to 138 (40 to 153)

(continued)

NOTE: *The values shown above in brackets must be used for checking purposes only.*

(cont)

12. DELIVERY PROGRESSION

Rev/min	Pressure LDA kPa	Delivery per 1000 shots: cm^3
500	25 (*)	63 to 64 (60.5 to 66.5)
1410	100	0 to 3 (0 to 3)
1360	100	17 to 27 (16 to 28)
1330	100	57 to 63 (52 to 68)
1250	100	62 to 65 (60 to 67)
750	100	74 to 75 (71.5 to 77.5)
500	0	51.5 to 53 (49 to 55)
350	100	78.5 to 81.5 (76.5 to 83.5)

13. DELIVERY CHECK AT IDLE SPEED

Rev/min		335	400	250
Delivery per 1000 shots	cm^3	8 to 12 (6 to 14)	0 to 3	27 to 33 (25 to 35)

(*) Adjust the LDA springs precharge adjustment ring nut. LDA stroke 0.165 to 0.244 in. (4.2 to 6.2 mm).

NOTE: *The values shown above in brackets must be used for checking purposes only.*

14. ZERO CAPACITY (STOP)

Rev/min	Voltage (volts)	Delivery per 1000 shots: cm^3
335	-	0 to 3

15. AUTOMATIC START SUPPLEMENT

Rev/min	Pressure LDA kPa	Delivery per 1000 shots: cm^3
100	-	80 to 120
250	-	43 to 73
150	-	82 to 132

BENCH TEST PERFORMANCE DATA

Test conditions

Fixed advance before TDC cylinder No. 1 in compression stroke: (see previous page)

Engine without fan, air filter and exhaust silencer.

Atmospheric pressure 29.13 ± 0.20 in. (740 ± 5 mm) mercury.

Relative humidity 70% ± 5.

Ambient temperature 77 °F (25 °C).

Specific gravity of diesel fuel 830 ±10 g/l

Throttle lever position	Braking load applied	Engine Speed rev/min	Power output with engine run-in for a total of: Production running-in kW (Hp)	Power output with engine run-in for a total of: 50 hours (total) kW (Hp)	Fuel consumption kg/h
Maximum	For maximum power output	2500	≥ 66.5 (90.5)	68 to 72 (92.5 to 98.5)	15.5 to 16.5
Maximum	For maximum torque	1500	-	50.8 to 54 (69.2 to 73.2)	11 to 11.6
Maximum	None (no-load)	2725 to 2775	-	-	-
Minimum	None (no-load)	625 to 675	-	-	-

FUEL SUPPLY PUMP DATA	inch (mm)
Eccentricity of drive shaft	0.1 (3)
Diameter of drive shaft at bushings	1.25 to 1.26 (31.975 to 32.000)
Internal diameter of installed and reamed bushings	1.26 to 1.26 (32.050 to 32.075)
Interference between bushings and seats	0.002 to 0.005 (0.063 to 0.140)
Assembly clearance between shaft and bushings	0.002 to 0.004 (0.050 to 0.100)
Thickness of internal washer	0.06 to 0.06 (1.45 to 1.50)
Thickness of external washer	0.11 to 0.1 (2.93 to 3.00)

CRANKCASE/CYLINDER BLOCK DATA	inch (mm)	
	Bore 100	Bore 104
Cylinder block	cast-iron monobloc with replaceable dry-fitted cylinder liners, incorporating seatings for crankshaft, camshaft and tappets	
Internal diameter of cylinder liners	3.937 to 3.937 (100.000 to 100.024) (1)	4.094 to 4.095 (104.000 to 104.024) (1)
External diameter of cylinder liners	4.055 to 4.057 (103.020 to 103.050)	4.213 to 4.214 (107.020 to 107.050)
Diameter of cylinder liner bores on block	4.049 to 4.051 (102.850 to 102.900)	4.206 to 4.208 (106.850 to 106.900)
Interference fit between cylinder liners and bores on the cylinder block	0.005 to 0.008 (0.120 to 0.200)	
Cylinder liners internal diameter oversizes	0.002 to 0.03 (0.4 to 0.8)	
Liner external diameter oversizes	0.008 (0.2)	
Maximum permissible liner ovality or taper due to wear (2)	0.005 (0.12)	
Main journal half bearing seat diameter	0.002 to 3.32 (84.200 to 84.230)	
Camshaft bushing seat diameter:		
- front	2.15 to 2.16 (54.780 to 54.805)	
- intermediate	2.14 to 2.13 (54.280 to 54.305)	
- rear	2.11 to 2.11 (53.780 to 53.805)	
Diameter of standard tappet bores in crankcase	0.6 to 0.6 (15.000 to 15.018)	
Spare tappet oversizes	0.004 - 0.008 - 0.001 (0.1 - 0.2 - 0.3)	

(1) Measured after press-fitting and reaming.

(2) Measure in the area swept by piston rings, both parallel and perpendicular to the crankshaft axis.

CRANKSHAFT AND BEARINGS DATA	inch (mm)	
	Bore 100	Bore 104
Crankshaft	balanced with integral counterweights	
Standard journal diameter	3.141 to 3.142 (79.791 to 79.810) (1)	
Journal undersizes	0.01 - 0.02 - 0.03 - 0.04 (0.254 - 0.508 - 0.762 - 1.016)	
Main journal half bearing thickness	0.0853 to 0.0857 (2.168 to 2.178)	
Main half bearing undersizes (internal diameter)	0.04 - 0.02 - 0.03 - 0.04 (0.254 - 0.508 - 0.762 - 1.016)	
Bearing shell to journal clearance	0.001 to 0.004 (0.034 to 0.103)	
Maximum permitted wear clearance	0.007 (0.180)	
Standard crankpin diameter	2.508 to 2.509 (63.725 to 63.744) (1)	
Crankpin undersizes	0.01 - 0.02 - 0.03 - 0.04 (0.254 - 0.508 - 0.762 - 1.016)	
Standard connecting rod half bearing thickness	0.07 to 0.07 (1.805 to 1.815)	
Connecting rod half bearing undersizes (internal diameter)	0.01 - 0.02 - 0.03 - 0.04 (0.254 - 0.508 - 0.762 - 1.016)	
Bearing to crankpin clearance	0.001 to 0.003 (0.033 to 0.087)	
Maximum permitted wear clearance	0.007 (0.180)	
Standard crankshaft thrust washer thickness	0.132 to 0.135 (3.378 to 3.429)	
Thrust washer oversizes (thickness)	0.05 - 0.01 - 0.015 - 0.02 (0.127 - 0.254 - 0.381 - 0.508)	
Width of main bearing including thrust washers	1.250 to 1.256 (31.766 to 31.918)	
Width of corresponding crankshaft journal	1.259 to 1.263 (32.000 to 32.100)	
Crankshaft assembly endfloat	0.003 to 0.013 (0.082 to 0.334)	
Maximum permitted wear endfloat	0.01 (0.40)	
Maximum ovality or taper of journals and crankpin after regrinding	0.0004 (0.01)	
Maximum ovality or taper of journals and crankpin	0.002 (0.05)	
Maximum tolerance for alignment of crankshaft journals with crankshaft supported on the two outer journals	0.004 (0.10)	
Maximum permitted tolerance, in both directions, on crankpin alignment of each pair of crankpins relative to crankshaft journals (4-cylinder engine)	0.01 (0.25)	
Maximum tolerance for run-out between the outer surfaces of the crankshaft journals and the crankshaft centreline	± 0.004 (± 0.10)	

(continued)

(1) Crankshafts with 0.004 in. (0.1 mm) undersize journals and crankpins and consequently undersize bearing shells may be fitted in factory production.

(cont)

CRANKSHAFT AND BEARINGS DATA	inch (mm)	
	Bore 100	Bore 104
Maximum permitted tolerance on run-out of flywheel mounting flange surface relative to the crankshaft centreline, measured with 1/100 mm scale dial gauge resting on front flange surface (A, Fig. 145) on a 4.25 in. (108 mm) diameter (total dial gauge reading)	0.001 (0.025)	
Maximum permitted tolerance on co-axial alignment of flywheel centering (B, Fig. 145) in relation to crankshaft journals (total dial gauge reading)	0.001 (0.04)	

CONNECTING ROD DATA	inch (mm)	
	Bore 100	Bore 104
Connecting Rods	cast-iron with oil way	
Diameter of small end bushing seat	1.647 to 1.648 (41.846 to 41.884)	
Outside diameter of small end bushing	1.652 to 1.654 (41.979 to 42.017)	
Interference between small end bushing and seat	0.004 to 0.01 (0.095 to 0.171)	
Inside diameter of small end bushing (measured after fitting) . . .	1.4962 to 1.4966 (38.004 to 38.014)	
Diameter of big end bearing seats	2.653 to 2.654 (67.407 to 67.422)	
Tolerance for parallelism between the small end and the big end axes measured at 4.92 in. (125 mm)	± 0.002 (± 0.07)	
Maximum weight difference between con rods in same engine . .	25 grams	

PISTON DATA	inches (mm)	
	Bore 100	Bore 104
Pistons	light alloy with three compression rings, including two seal rings and one scraper ring	
Standard piston diameter, measured at 57 mm from skirt base and perpendicularly to the gudgeon pin axis	3.9301 to 3.9307 (99.827 to 99.841)	4.0870 to 4.0876 (103.812 to 103.826)
Piston clearance in cylinder liner	0.006 to 0.01 (0.159 to 0.197)	0.0068 to 0.008 (0.174 to 0.212)
Maximum permitted wear clearance	0.01 (0.30)	
Piston oversizes	0.01 - 0.03 (0.4 - 0.8)	
Piston protrusion at TDC from cylinder block face	0.01 to 0.03 (0.355 to 0.761)	
Gudgeon pin diameter	1.4953 to 1.4956 (37.983 to 37.990)	
Diameter of gudgeon pin seat in piston	1.4957 to 1.4960 (37.993 to 38.000)	
Gudgeon pin to seat clearance	0.0001 to 0.0006 (0.003 to 0.017)	
Gudgeon pin to small end bearing clearance	0.0005 to 0.0012 (0.014 to 0.031)	
Maximum permitted wear clearance	0.002 (0.06)	
Maximum weight difference between pistons in same engine	20 grams	
Piston ring groove clearance (measured vertically):		
- 1° ring	0.003 to 0.004 (0.090 to 0.122)	
- 2° ring	0.0023 to 0.0036 (0.060 to 0.092)	
- 3° ring	0.0017 to 0.0029 (0.040 to 0.075)	
Maximum permitted wear clearance:		
- 1° ring	0.02 (0.50)	
- 2° and 3° ring	0.008 (0.20)	
Assembly clearance between piston ring ends in cylinder sleeves:		
- 1° ring	0.0137 to 0.0216 (0.35 to 0.55)	0.0157 to 0.0255 (0.40 to 0.65)
- 2° ring	0.0118 to 0.0177 (0.30 to 0.45)	0.0118 to 0.0216 (0.30 to 0.55)
- 3° ring	0.0118 to 0.0236 (0.30 to 0.60)	
Maximum permissible gap (wear limit)	0.0472 (1.20)	

VALVE TIMING GEAR DATA	inches (mm)	
	Bore 100	Bore 104
Timing gear tooth backlash	0.0062 (0.160)	
Inside diameter of intermediate gear bushings (fitted and reamed)	1.459 to 1.460 (37.050 to 37.075)	
Diameter of intermediate gear journal	1.456 to 1.457 (36.975 to 37.000)	
Clearance between pin and relative bushings	0.0019 to 0.0039 (0.050 to 0.100)	
Maximum permitted wear clearance	0.0059 (0.15)	
Bushing interference fit in seat in intermediate gear	0.0024 to 0.0055 (0.063 to 0.140)	
Outside diameter of camshaft bearings:		
- front	2.160 to 2.163 (54.875 to 54.930)	
- intermediate	2.141 to 2.143 (54.375 to 54.430)	
- rear	2.121 to 2.123 (53.875 to 53.930)	
Interference between bearings and seats in cylinder block	0.0027 to 0.0059 (0.070 to 0.150)	
Inside diameter of camshaft bearings (fitted and reamed):		
- front	2.011 to 2.013 (51.080 to 51.130)	
- intermediate	1.991 to 1.993 (50.580 to 50.630)	
- rear	1.972 to 1.974 (50.080 to 50.130)	
Diameter of camshaft journals:		
- front	2.007 to 2.008 (50.970 to 51.000)	
- intermediate	1.987 to 1.988 (50.470 to 50.500)	
- rear	1.967 to 1.969 (49.970 to 50.000)	
Clearance between camshaft journals and bushings	0.0031 to 0.0062 (0.080 to 0.160)	
Maximum permitted wear clearance	0.0078 (0.20)	
Camshaft endfloat between thrust plate and seat on camshaft	0.0027 to 0.086 (0.070 to 0.220)	
For further timing system technical data	see page 4	

TAPPET DATA	inches (mm)	
	Bore 100	Bore 104
Tappet bore in crankcase	0.5906 to 0.5913 (15.000 to 15.018)	
Outside diameter of standard tappet	0.5886 to 0.5894 (14.950 to 14.970)	
Tappet running clearance	0.0011 to 0.0026 (0.030 to 0.068)	
Maximum permitted wear clearance	0.0059 (0.15)	
Tappet oversizes	0.0039 - 0.0078 - 0.0118 (0.1 - 0.2 - 0.3)	

ROCKER ARM - VALVE DATA	inches (mm)	
	Bore 100	Bore 104
Diameter of shaft bores in rocker arms	0.7093 to 0.7100 (18.016 to 18.034)	
Diameter of rocker arm shaft	0.7080 to 0.7087 (17.982 to 18.000)	
Rocker shaft to rocker arm bore clearance	0.0006 to 0.0020 (0.016 to 0.052)	
Maximum permitted wear clearance	0.0059 (0.15)	
Rocker arm spacing springs:		
- free length	2.343 (59.5)	
- length under load of 46 to 52 N (4.7 to 5.3 kg)	1.732 (44)	
Valve clearance for timing check	0.0177 (0.45)	
Valve clearance for normal running (engine cold):		
- inlet valve	0.018 ± 0.0019 (0.30 ± 0.05)	
- exhaust valve	0.018 ± 0.0019 (0.30 ± 0.05)	
Cam lift:		
- inlet valve	0.2232 (5.67)	
- exhaust valve	0.2343 (5.95)	

MAIN DATA FOR EQUALIZER WITH ROTATING COUNTERWEIGHTS (Fig. 110)	inches (mm)
Bushing (28) interference fit in seat on gear unit (26)	0.0024 to 0.0055 (0.063 to 0.140)
Clearance between intermediate gear journal (27) and bushing (28)	0.0019 to 0.039 (0.050 to 0.100)
Interference between bushings and support seats (20)	0.0024 to 0.0055 (0.063 to 0.140)
Clearance between gear unit shaft (22) and relative bushings	0.0019 to 0.0039 (0.050 to 0.100)
Clearance between sides of sleeve grooves (17), drive gear unit connection (22) and rotating weight gear unit (13)	0.0014 to 0.0041 (0.038 to 0.106)
Interference between front bush (16) and seat on casing (12)	0.0024 to 0.0055 (0.063 to 0.140)
Clearance between rotating weight shaft (13) and front bush (16)	0.0019 to 0.0039 (0.050 to 0.100)
Interference between rotating weight rear bush (13) and seat on support (7)	0.0014 to 0.0039 (0.037 to 0.101)
Clearance between shaft (13) and rear bush	0.0005 to 0.0024 (0.013 to 0.061)
Interference between bushings and relative seats on weights (6)	0.0015 to 0.0039 (0.040 to 0.100)
Clearance between rotating weight axis (5) and relative bushings	0.0007 to 0.0028 (0.020 to 0.073)
Interference between intermediate gear bush (10) and relative seat on rotating weight casing (12)	0.0014 to 0.0039 (0.037 to 0.101)
Clearance between intermediate gear shaft (10) and relative bush	0.0005 to 0.0024 (0.013 to 0.061)
Clearance between the teeth and the coupled wheels	0.0031 (0.080)

CYLINDER HEAD DATA	inches (mm)	
	Bore 100	Bore 104
Cylinder head	with valve seats cut directly in the casting and press-fitted steel valve guides	
Original height of cylinder head	3.622 (92)	
Maximum face re-grinding depth. that can be removed from the cylinder head in the event of reboring	0.019 (0.5)	
Diameter of standard valve guide bores in head	0.5492 to 0.5505 (13.950 to 13.983)	
Outside diameter of standard valve guides	0.5509 to 0.5518 (13.993 to 14.016)	
Guide interference fit in bores	0.0003 to 0.0023 (0.010 to 0.066)	
Inside diameter of valve guide (fitted in head)	0.3159 to 0.3167 (8.023 to 8.043)	
Valve stem diameter	0.3144 to 0.3150 (7.985 to 8.000)	
Assembly clearance between valve stem and guide	0.0009 to 0.0022 (0.023 to 0.058)	
Maximum permitted wear clearance	0.0051 (0.13)	
Maximum run-out of valve guided on its stem measured through 360□ with dial gauge contact point resting on valve head contact band	0.0011 (0.03)	
Spare valve guide oversizes	0.0078 (0.2)	
Valve seat angle in head:		
- inlet valve	60° ± 5’	
- exhaust valve	45° ± 5’	
Valve face angle:		
- inlet valve	60° 30’ ± 7’	
- exhaust valve	45° 30’ ± 7’	
Valve head diameter:		
- inlet valve	1.783 to 1.791 (45.300 to 45.500)	
- exhaust valve	1.476 to 1.486 (37.500 to 37.750)	
Valve stand-in relative to cylinder head face	0.027 to 0.039 (0.7 to 1.0)	
Maximum permissible valve stand-in	0.0511 (1.3)	
Inlet and exhaust valve springs:		
- free length	1.756 (44.6)	
- length with valve closed, under load of 256 to 284 N (26.1 to 28.9 kg)	1.339 (34)	
- length with valve open, under load of 502 to 554 N (51.2 to 56.5 kg)	0.9370 (23.8)	
Injector protrusion relative to head face:		
● BOSCH injector no. 500317389. 500307714	0.0118 to 0.0433 (0.3 to 1.1)	

LUBRICATION SYSTEM DATA	inches (mm)	
	TL70 and TL80	TL90 and TL100
Assembly clearance between oil pump drive shaft and bushing	0.0062 to 0.0021 (0.016 to 0.055)	-
Clearance between shaft and driven gear	0.0012 to 0.0025 (0.033 to 0.066)	-
Tooth backlash between drive and driven gears	0.0039 (0.100)	-
Radial clearance between drive and driven gears and housing	0.0023 to 0.0066 (0.060 to 0.170)	-
Thickness of drive and driven gears	1.613 to 1.614 (40.961 to 41.000)	-
Height of gear seat in pump	1.615 to 1.618 (41.025 to 41.087)	-
Endfloat between gears and gear housing in pump	0.0009 to 0.0049 (0.025 to 0.126)	-
Pressure relief valve spring		-
- spring free length	1.772 (45)	1.413 (35.9)
- length under load of 45 to 49 N (4.6 to 5 kg)	1.476 (37.5)	-
- length under load of 88 to 94 N (9 to 9.6 kg)	1.201 (30.5)	-
- spring length (2, fig. 167) under load of 127.8 to 141.2 N (130 to 144 kg)	-	1.142 (29)
- spring length (2, fig. 167) under load of 233.4 to 258 N (238 to 263 kg)	-	0.9134 (23.2)
For further lubrication technical data	see page 3	-

COOLING SYSTEM DATA	inches (mm)	
	Bore 100	Bore 104
Interference fit between pump impeller and shaft	0.0006 to 0.0023 (0.017 to 0.059)	
Interference fit between fan hub and shaft	0.0009 to 0.0022 (0.024 to 0.058)	
Interference fit between front seal bushing and impeller	0.0004 to 0.0022 (0.012 to 0.058)	
For further cooling system technical data	see page 3	

ANGLE TORQUE SETTINGS

PART TO BE TIGHTENED	Thread	Tightening torque		Angle
		Nm	kgm	
Cylinder head retaining screws (2, fig. 3)	M 12 x 1.25	70	7.1	90° + 90°
Main bearing cap bolts (4)	M 14 x 1.5	80	8.2	90°
Big-end cap bolts (5)	M 11 x 1.5	40	4.1	60°
Flywheel mounting bolts (3)	M 12 x 1.25	40	4.1	60°

TORQUE SETTINGS

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Rocker shaft pedestal bolts (1, fig. 3)	M 8	25	2.5
Crankshaft hub retaining nut (7)	M 30 x 1.5	294	30
Fan and alternator pulley bolts (6)	M 10 x 1.25	55	5.6
Additional rotating weight retaining bolts (1, fig. 4)	M 12 x 1.25	110	11.2
Intake manifold retaining bolts (1, fig. 70)	M 8	25	2.6
Alternator and belt tension adjustment nut (1, fig. 56)	M 10 x 1.25	55	5.6
Coolant pump retaining bolts (1, fig. 61)	M 10 x 1.25	55	5.6
Tappet cover nuts (1, fig. 82)	M 8	15	1.5
Rocker shaft pedestal bolts (2, fig. 83)	M 8	25	2.5
Oil pump and cover retaining bolts (1, fig. 91)	M 8	25	2.6
Timing gear case and cover bolts (1, fig. 95)	M 8	25	2.6
Intermediate flanged journal bolts (1, fig. 98)	M 10 x 1.25	55	5.6
Camshaft thrust plate retaining bolts (2, fig. 99)	M 8	35	3.6
Rear crankcase cover bolts (2, fig. 119)	M 8	25	2.6
Tappet adjuster locknuts (1, fig. 138)	M 8	22	2.2
Exhaust manifold retaining bolts (1, fig. 66)	M 8	25	2.6
Engine sump retaining bolts (4, fig. 88) to: - rear seal cover, timing gear cover and casing, crankcase and flywheel casing: • models TL70 and TL80 ..... • models TL90 and TL100	 M 10 x 1.25 M 10 x 1.25 M 10 x 1.25	 39 to 49 49 to 59 49 to 69	 4 to 5 5 to 6 5 to 7

TIGHTENING TORQUES

Nuts for injector mounting studs (1. fig. 139)	M 8	25 **(*)**	2.6 **(*)**
Injection pump retaining bolts (1, fig. 217)	M 8	25	2.6

(*) Tighten the nuts in two stages - see operations described in fig. 139.

TOOLS

Warning - The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**.

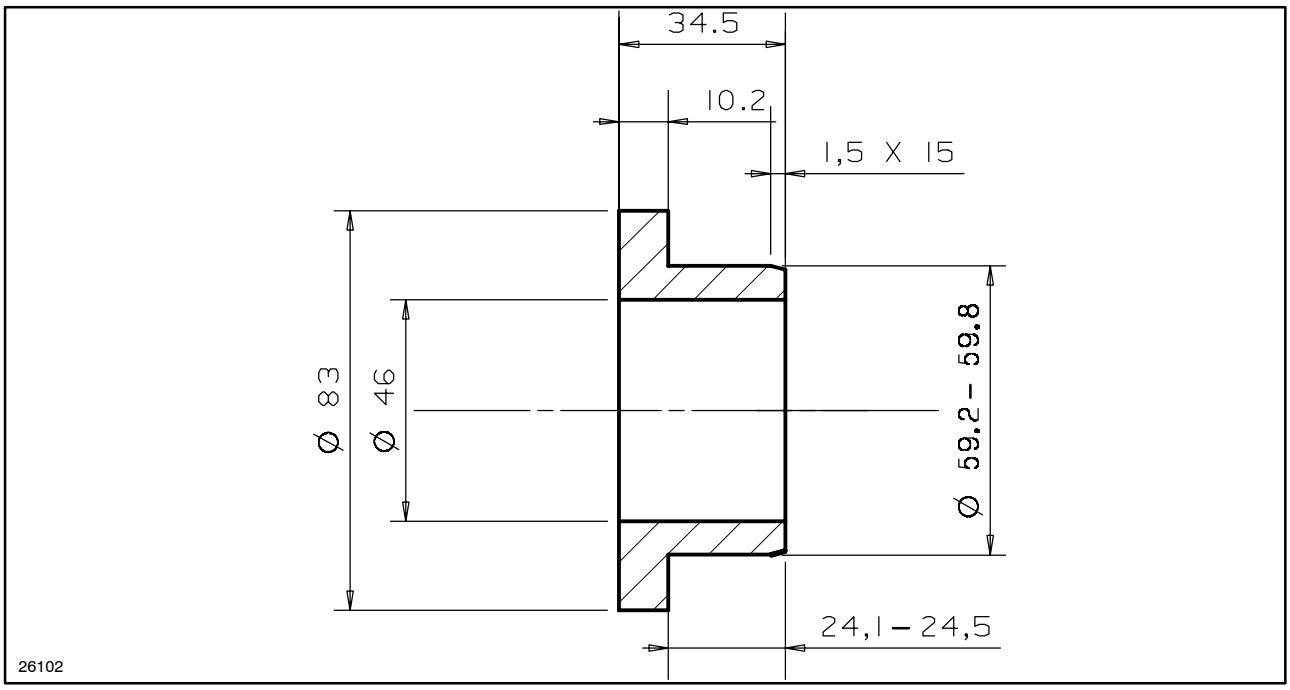
To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

	380000236	Tractor disassembly stand.
	380000216	Engine lifting hook.
	380000301	Revolving engine service stand.
	380000313	Set of engine mounting brackets for revolving stand **380000301**.
	380000240	Engine oil pressure test kit.
X	**380000303**	Compression test kit (complete with dummy injector **293862**).
X	**380000328**	Device for engine belt tension check.
X	**380000221**	Piston ring pliers.
X	**380000220**	Clamp for fitting pistons in cylinders.
X	**380000304**	Protractor for angular torque measurement.
X	**380000226**	Puller for crankshaft pulley hub.
X	**380000232**	Wrench for valve clearance adjustment.
X	**380000219**	Drift for valve guide extraction / installation.
X	**380000276**	Twist bit for enlarging valve guide bore.
X	**380000277**	8° Tapered grinder for swaging exhaust valve guides.
X	**380000242**	Bush for valve guide installation (with **380000219**).
X	**380000222**	Engine valve guide reamer.
X	**380000302**	Engine valve spring disassembly–assembly compressor.
X	**380000223**	Puller for coolant pump impeller.
X	**380000247**	Drift for installation of coolant pump impeller seal.
X	**380000259**	Compressor rotor extractor (models TL90, TL100).
X	**380000292**	Pin for clutch assembly.
X	**8824959**	Brackets for lifting engine (Quantity = 2).
X	**380000322**	Tool for disassembly of injection pump gear unit.
X	**380000246**	Set of grinding tools for regrinding injector seat.
	380000311	Wrench for injection pump delivery line unions.
	380000254	Kit for injector cleaning.
X	**380000309**	Wrench set for injector dismantling (with **295008**).
	380000310	Hand pump for injector calibration test.

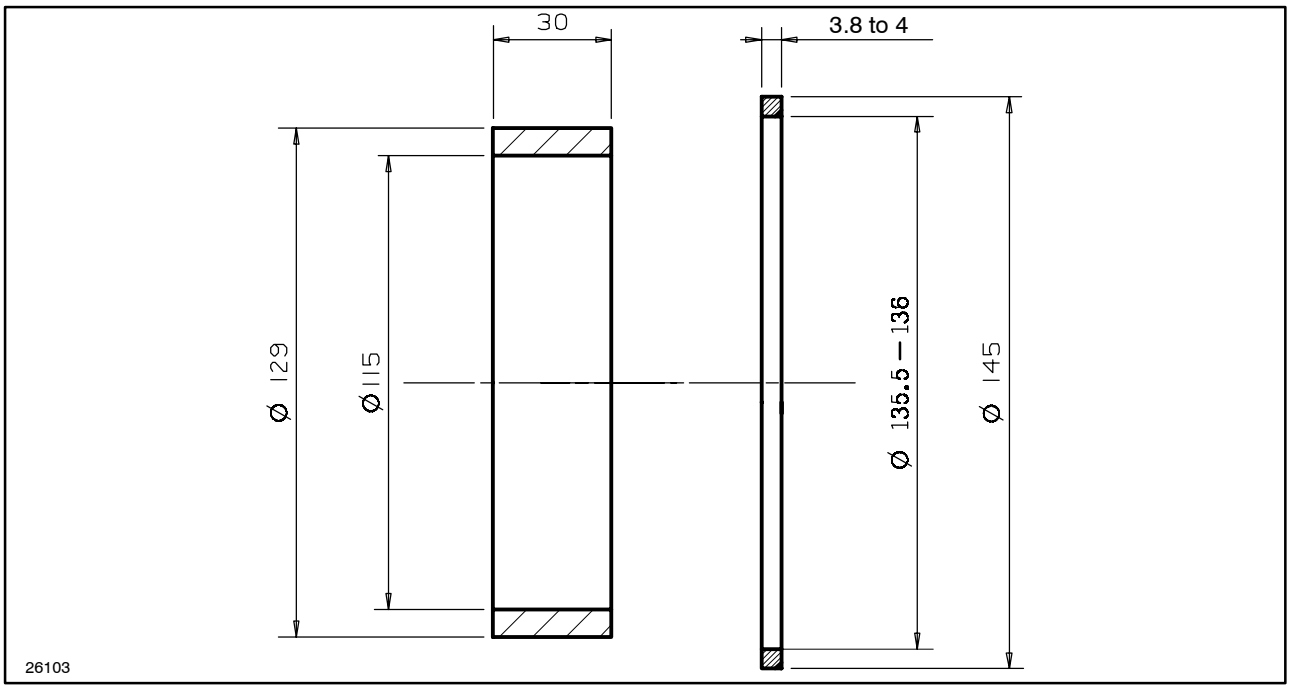
Injection pump bench test

	380000228	Dial gauge (1/100 mm scale, 5 mm stroke, ∅ 1.574 in. (40 mm) with **380000229**).
	380000229	Device for BOSCH injection pump timing on engine (with **380000228**).
	380000322	Puller for injection pump drive gear.



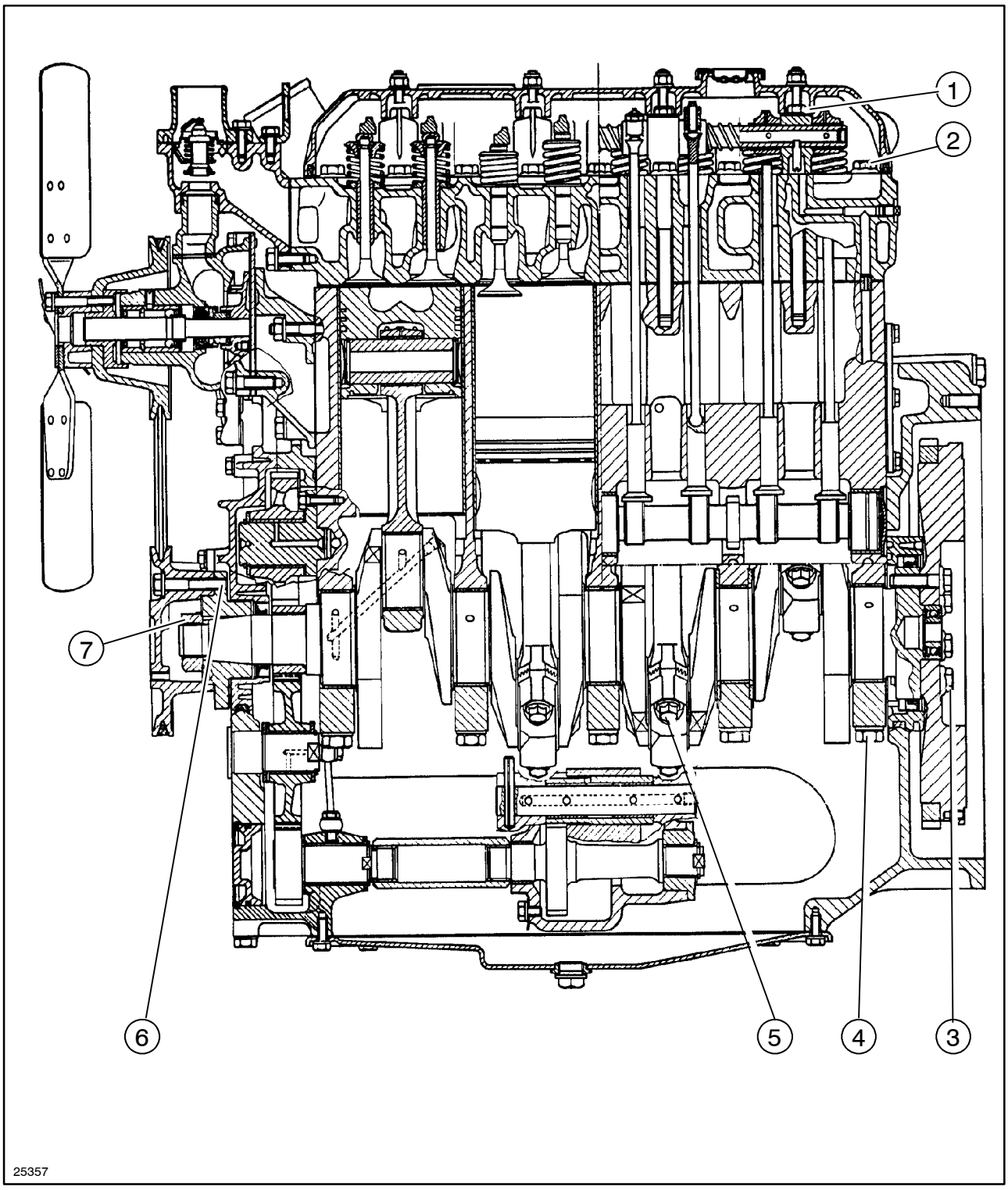
1

Splining tool to be manufactured for assembling the crankshaft front seal (print No. 50138 - Dimensions in mm).
Make in UNI C40 material.



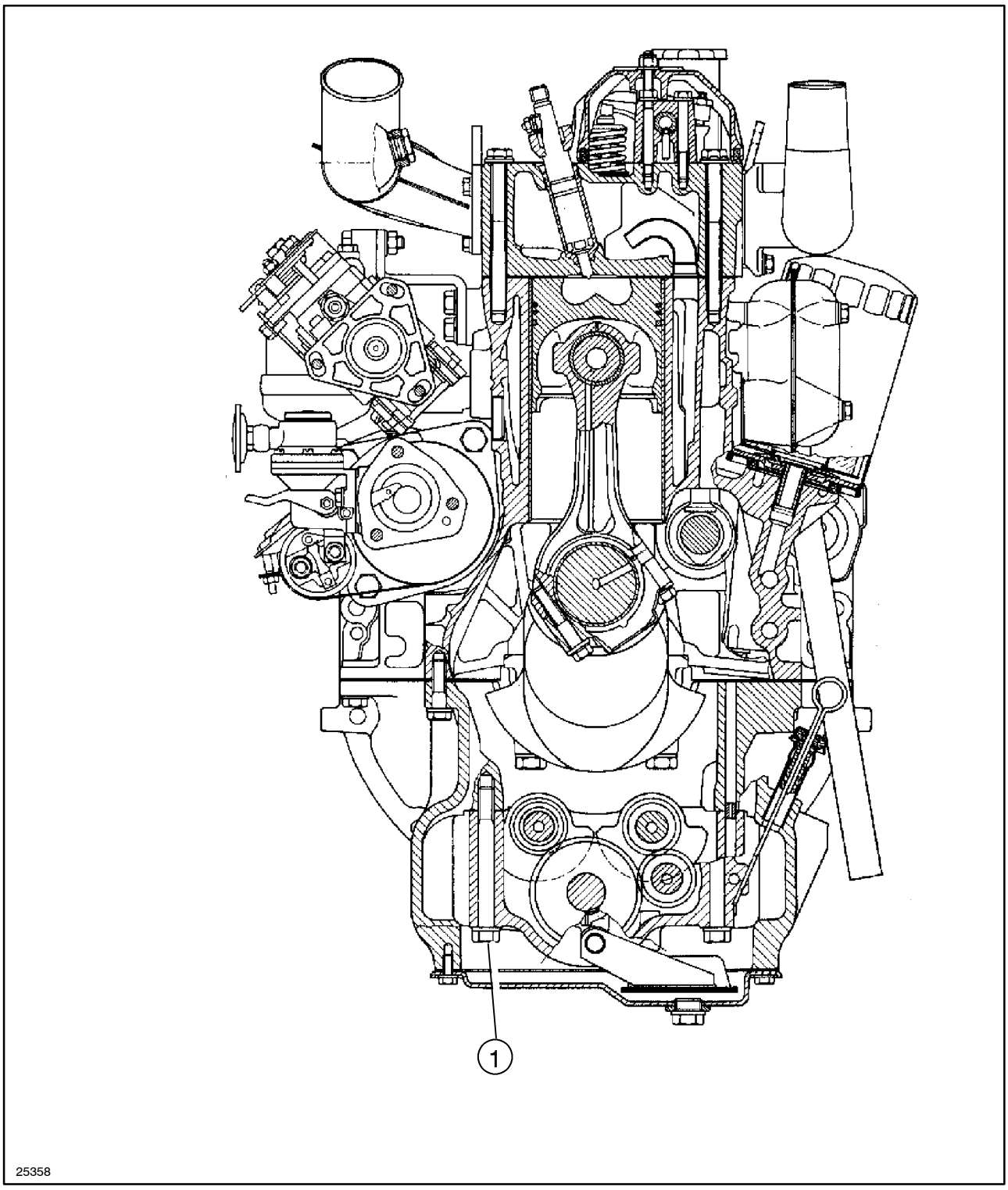
2

Splining tool to be manufactured for assembling the crankshaft rear seal (print No. 50139 - Dimensions in mm).
Make in UNI C40 material.



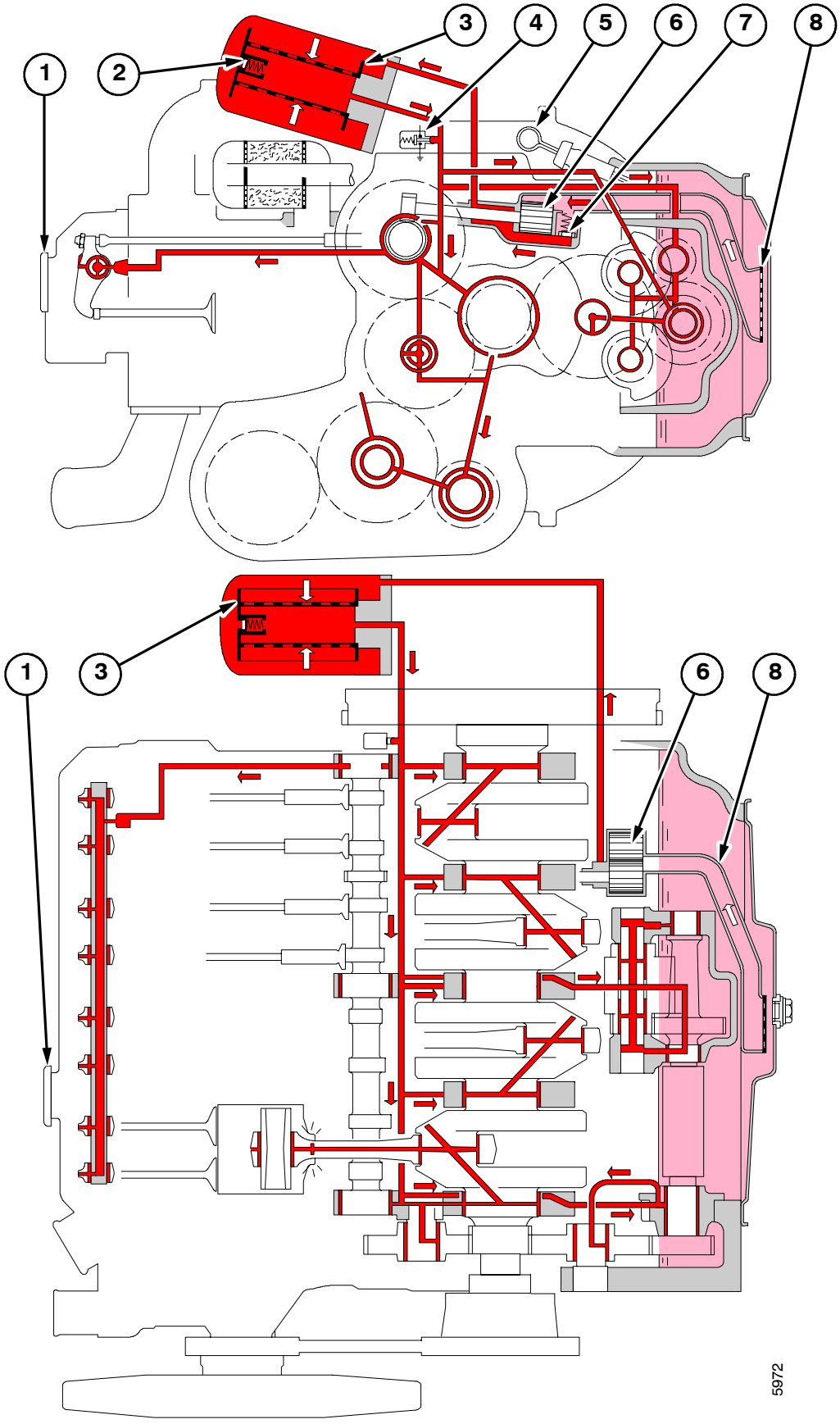
3

Engine longitudinal cross section - 4-cylinder models TL70 and TL80



4

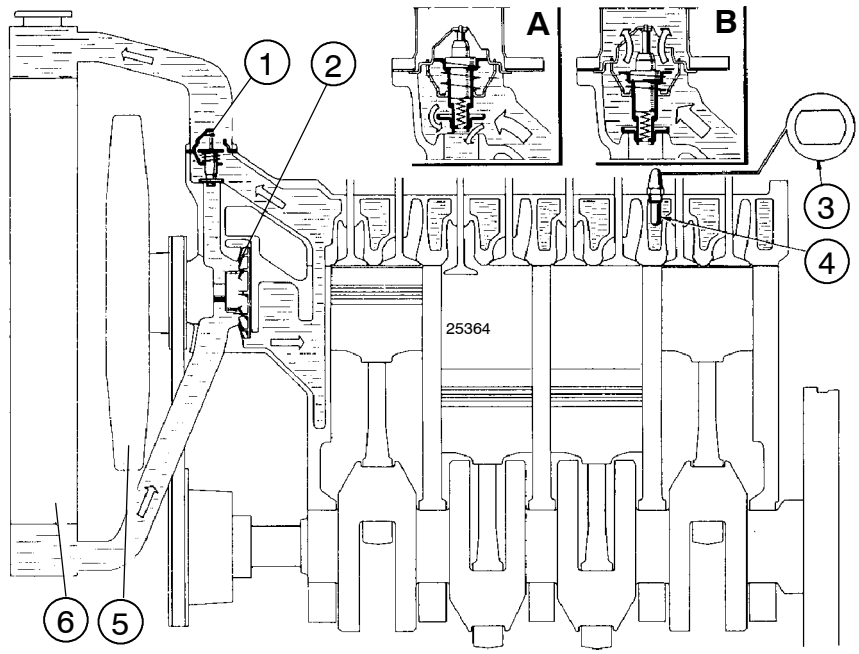
Engine longitudinal cross section - 4-cylinder models TL70 and TL80



5

4-cylinder engine lubrication system diagram

1. Oil filler cap - 2. Filter safety valve (opens when oil pressure at filter infeed exceeds the outfeed pressure by 21.75-24.66 psi (1.5-1.7 bar)
3. Filter - 4. Engine lubrication oil low pressure indicator light switch (on dashboard) - 5. Dipstick - 6. Pump - 7. Oil pressure limiting valve - 8. Mesh filter on intake



25364

6

Engine cooling system circuit diagram.

A. Coolant circulation with thermostat closed.
B. Coolant circulation with thermostat open.
1. Thermostat.
2. Pump.
3. Electric thermometer for engine coolant temperature.
4. Temperature transmitter.
5. Fan.
6. Radiator.

ENGINE TROUBLESHOOTING

Problems	Possible Causes	Solutions
Engine does not start.	1. Battery partially discharged.	Check and recharge battery. Replace if necessary.
	2. Battery terminal connections corroded or loose.	Clean, inspect and tighten terminal nuts. Replace terminals and nuts if excessively corroded.
	3. Injection pump timing incorrect.	Adjust injection pump timing.
	4. Impurities or water in fuel lines.	Disconnect fuel lines from injection pump and clean thoroughly. If necessary clean and dry the fuel tank.
	5. No fuel in tank.	Fill tank.
	6. Fuel supply pump malfunction.	Check and replace pump if necessary.
	7. Air in fuel system.	Check fuel lines, unions, supply pump, filters and injection pump for air; then bleed the air from the circuit.
	8. Starter motor faulty.	Repair or replace starter motor.
	9. Thermostarter faulty.	Check and replace thermostarter if necessary.
Engine stalls.	1. Idle speed too low.	Adjust idle speed.
	2. Injection pump delivery irregular.	Check injection pump delivery on test bench.
	3. Impurities or water in fuel lines.	Disconnect fuel lines from injection pump and clean thoroughly. If necessary clean and dry the fuel tank.
	4. Fuel filters clogged.	Replace the filter cartridges.
	5. Incorrect valve - rocker arm clearances.	Adjust the clearance between the rocker arms and the valves.
	6. Burnt or cracked valves.	Replace the valves.
	7. Air in fuel system.	Check fuel lines, unions, supply pump, filters and injection pump for air; then bleed the air from the circuit.
	8. Injection pump drive mechanism damaged.	Replace damaged parts.

(continued)

ENGINE TROUBLESHOOTING

(cont)

Problems	Possible Causes	Solutions
Engine overheating.	1. Coolant pump malfunction.	Overhaul pump and replace if necessary.
	2. Thermostat faulty.	Replace the thermostat.
	3. Radiator inefficient.	Remove internal deposits by flushing. Check for leaks and repair.
	4. Deposits in cylinder head and crankcase coolant passages.	Flush out coolant system.
	5. Coolant pump and fan drive belt slack.	Check and adjust belt tension.
	6. Coolant level low.	Top up expansion tank with specified coolant mixture.
	7. Incorrect engine timing.	Check and adjust engine timing.
	8. Injection pump calibration incorrect - delivering too much or too little fuel.	Calibrate pump on test bench to values specified in calibration tables.
	9. Air filter clogged.	Clean filter unit and replace filter element if necessary.
Engine lacks power and runs unevenly.	1. Injection pump timing incorrect.	Adjust injection pump timing.
	2. Auto advance regulator in injection pump damaged.	Overhaul injection pump and adjust on test bench to values specified in calibration table.
	3. Distributor journal worn.	Overhaul injection pump and adjust on test bench to values specified in calibration table.
	4. Injection pump delivery irregular.	Overhaul injection pump and adjust on test bench to values specified in calibration table.
	5. All-speed governor damaged.	Overhaul injection pump and adjust on test bench to values specified in calibration table.
	6. Injectors partially obstructed or damaged.	Clean and overhaul injectors and adjust pressure setting.
	7. Impurities or water in fuel lines.	Disconnect fuel lines from injection pump and clean thoroughly. If necessary clean and dry the fuel tank.

(continued)

ENGINE TROUBLESHOOTING

(cont)

Problems	Possible Causes	Solutions
	8. Fuel supply pump damaged.	Replace fuel supply pump.
	9. Incorrect valve - rocker arm clearances.	Adjust the clearance between the rocker arms and the valves.
	10. Cylinder compression low.	Test compression and overhaul engine if necessary.
	11. Air filter clogged.	Clean filter unit and replace filter element if necessary.
	12. Tie-rod in linkage between accelerator and injection pump incorrectly adjusted.	Adjust to correct length.
	13. Maximum speed screw on injection pump incorrectly adjusted.	Adjust max. speed screw.
Engine produces abnormal knocking noises.	1. Injectors partially obstructed or damaged.	Clean and overhaul injectors and adjust pressure setting.
	2. Impurities accumulating in fuel lines.	Clean fuel lines and replace severely dented pipes; clean injection pump if necessary.
	3. Injection pump timing incorrect.	Adjust injection pump timing.
	4. Crankshaft knocking due to excessive play in one or more main or big-end bearings or excessive endfloat.	Re-grind crankshaft journals and crankpins. Fit oversize shell bearings and thrust washers.
	5. Crankshaft out of balance.	Check crankshaft alignment and balance; replace if necessary.
	6. Flywheel bolts loose.	Replace any bolts that have worked loose and tighten all bolts to the specified preliminary and angular torque values.
	7. Connecting rod axes not parallel.	Straighten connecting rods, check axes parallelism; replace con rods if necessary.
	8. Pistons knock due to excessive wear.	Rebore cylinder liners and fit oversize pistons.
	9. Noise caused by excessive play of gudgeon pins in small-end and piston bushings. Loose fit of small-end bushing.	Fit oversize gudgeon pin, rebore piston seats and small-end bushings. Replace with new bushings.
	10. Excessive tappet / valve noise.	Check for broken springs or excessive play between valve stems and guides, cam followers and bores; adjust valve clearances.

(continued)

ENGINE TROUBLESHOOTING

(cont)

Problems	Possible Causes	Solutions
Engine produces excessive black or dark grey smoke.	1. Maximum delivery of injection pump too high.	Calibrate pump on test bench to values specified in calibration tables.
	2. Injection pump delivery excessively retarded or automatic advance regulator damaged.	Adjust injection pump timing or check automatic advance regulator.
	3. Injection pump delivery excessively advanced.	Adjust injection pump timing.
	4. Injectors partially or totally obstructed or incorrectly adjusted.	Clean and overhaul injectors and adjust pressure setting; replace if necessary.
	5. Air filter clogged.	Clean filter unit and replace filter element if necessary.
	6. Loss of engine compression due to: - piston rings sticking; - cylinder liner wear; - worn or incorrectly adjusted valves.	Replace damaged parts or, if necessary, overhaul the engine.
	7. High-pressure fuel lines damaged.	Inspect and replace if necessary.
Blue, grey-blue or grey-white smoke.	1. Injection pump delivery excessively retarded or automatic advance regulator damaged.	Adjust injection pump timing or check automatic advance regulator.
	2. Injectors obstructed or damaged.	Clean, overhaul and calibrate injectors, replace if necessary.
	3. Oil leaking past piston rings due to sticking rings or cylinder liner wear.	Replace damaged parts or, if necessary, overhaul the engine.
	4. Oil leaking through the inlet valve guides due to guide or valve stem wear.	Overhaul cylinder head.
	5. Engine does not reach correct operating temperature (thermostat faulty).	Replace the thermostat.
Engine runs on after switching off.	1. Engine stop electromagnet damaged.	Replace electromagnet.
	2. All-speed governor damaged.	Overhaul injection pump and adjust on test bench to values specified in calibration table.

Op. 10 001 10
ENGINE R.I.

DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

CAUTION

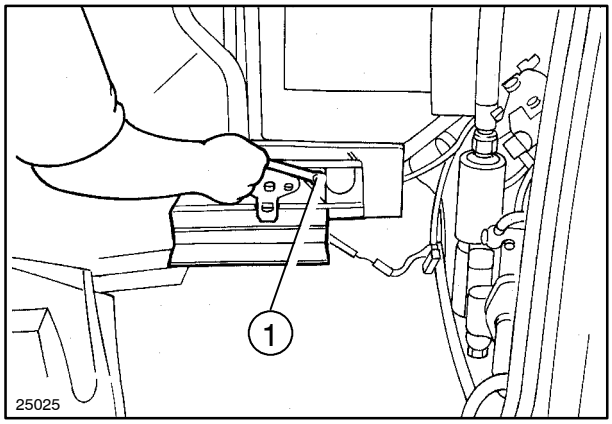
Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

1. Disconnect the battery negative cable (A).

2. Drain the oil from the transmission-gearbox housing.

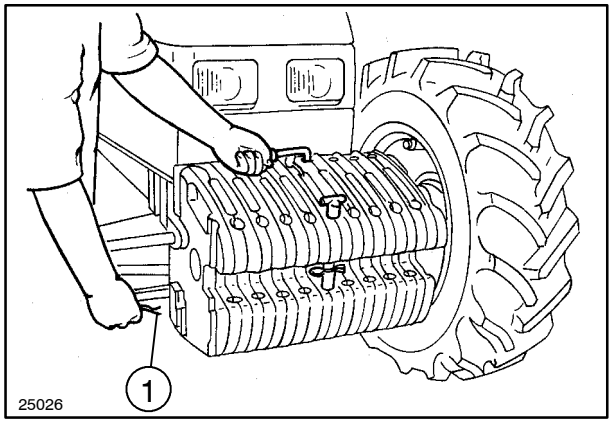
3. Drain off the coolant from the engine cooling system.

4. Remove the tool box and relative support bracket (1).



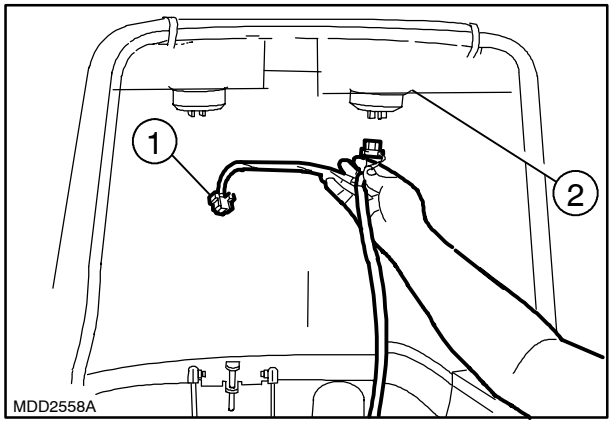
7

5. Remove the split pins, lock pins and front ballast (1).



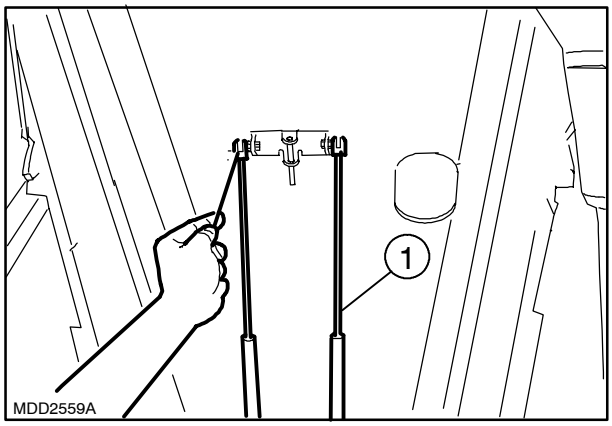
8

6. Remove the exhaust pipe, raise the bonnet and disconnect the front headlight (2) connections (1).



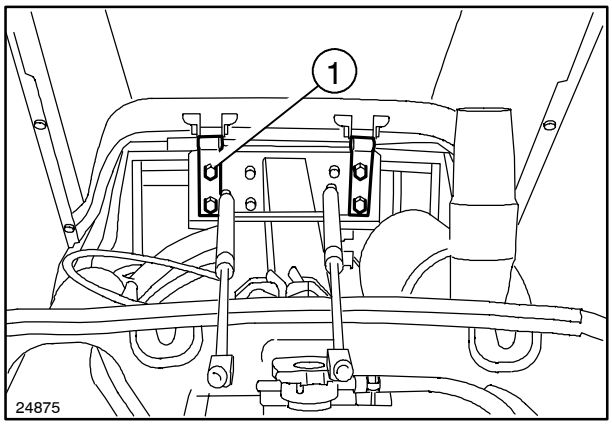
9

7. Disconnect the gas springs (1) from the bonnet.



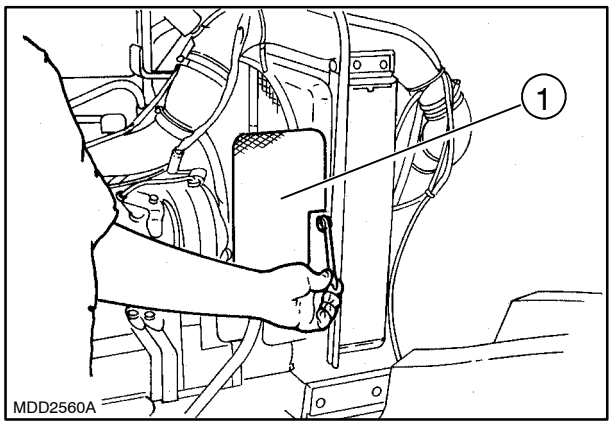
10

8. Unscrew the four bolts (1) retaining the hinge bracket and remove the bonnet.



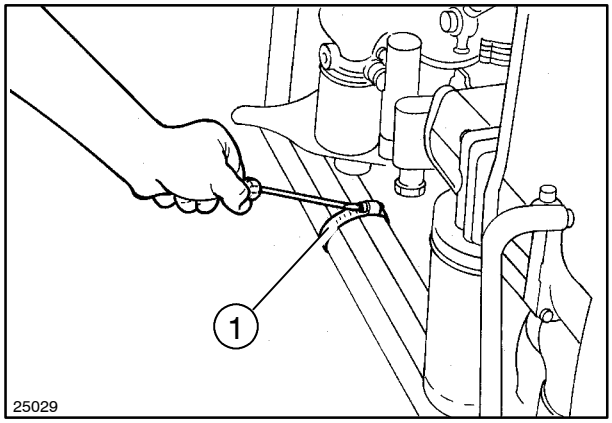
11

9. Remove the fan guard (1) on the right-hand side.



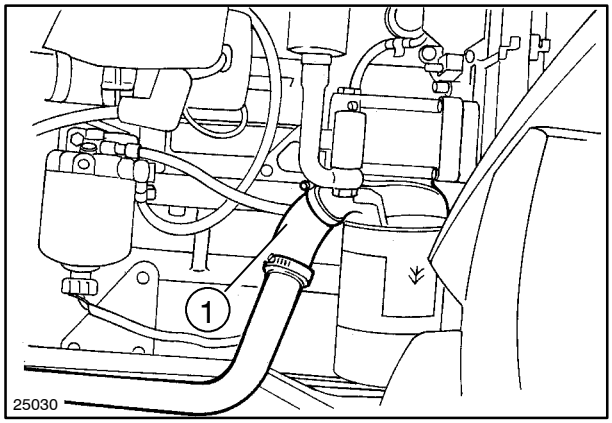
12

10. Remove the metal clamp (1) securing the rigid oil pump and lift oil delivery lines.



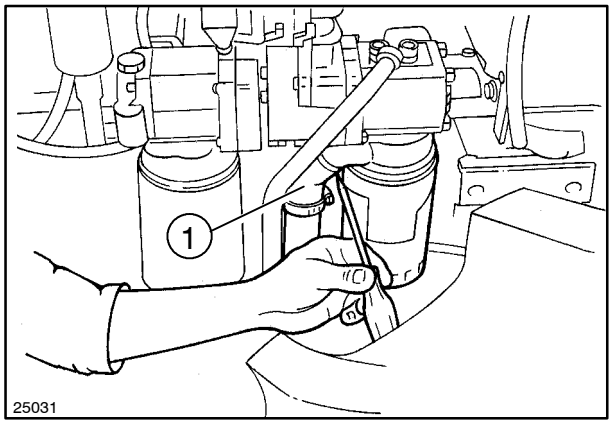
13

11. Extract the sleeve (1) on the services pump priming pipe.



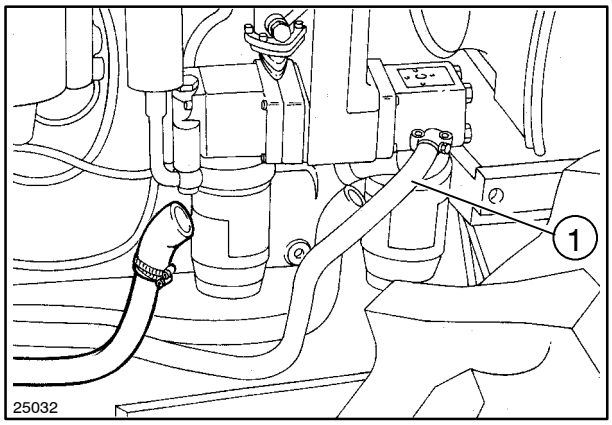
14

12. Extract the sleeve (1) on the lift pump priming pipe.



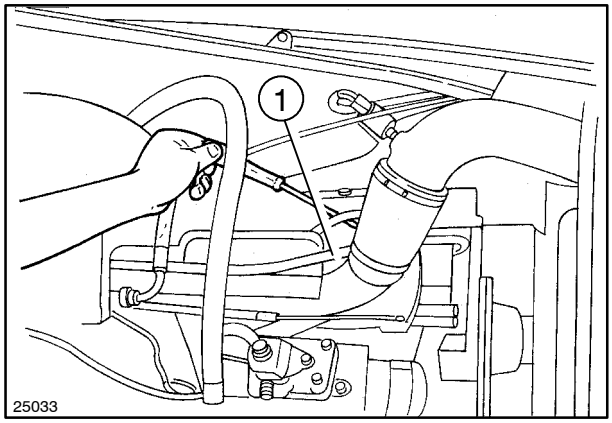
15

13. Detach the lift pump delivery line (1).



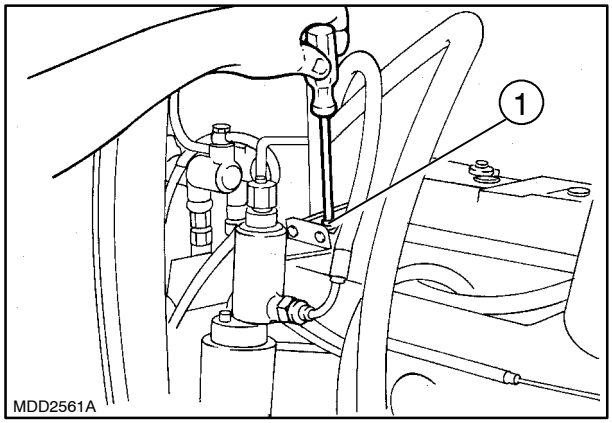
16

14. Detach the fuel line (1) and the glowplug.



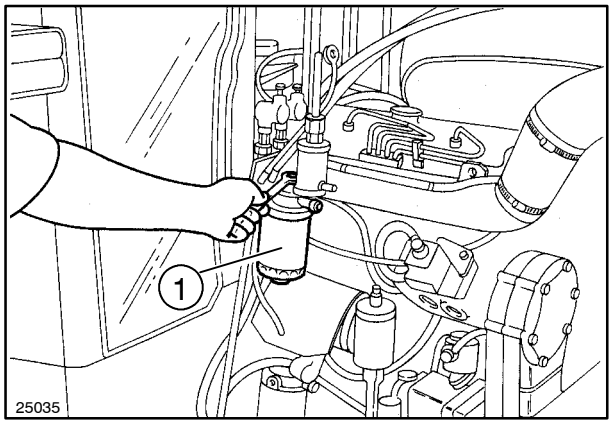
17

15. Detach the injectors fuel recovery line (1) and the tank/decanting filter connecting line.



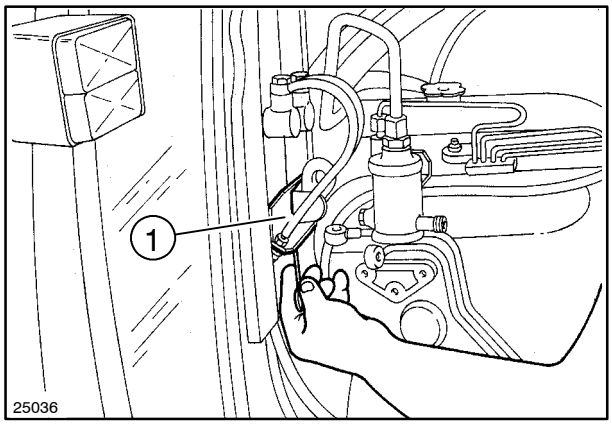
18

16. Detach the support, complete with diesel filter (1).



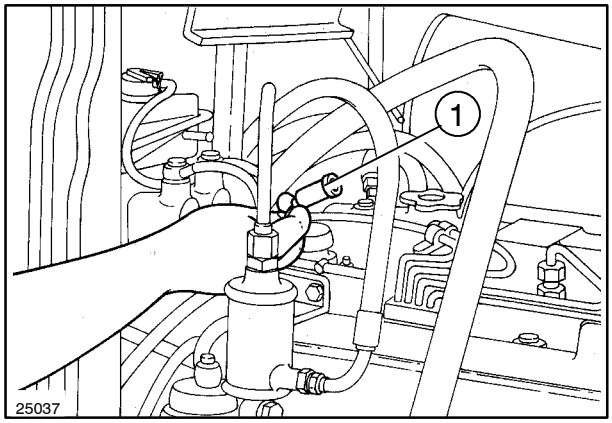
19

17. Remove the brakes flexible piping retaining bracket (1).



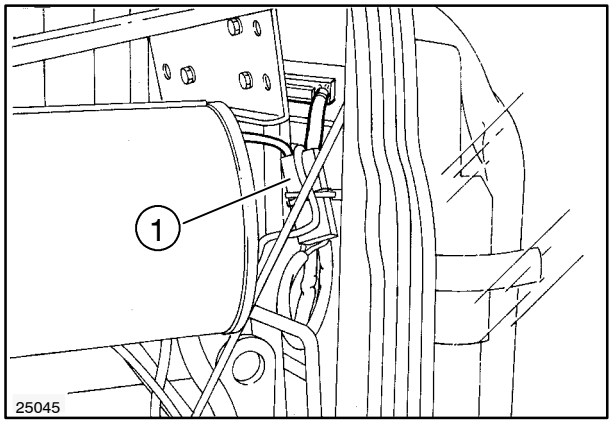
20

18. Disconnect the coolant temperature sensor electrical connection (1).



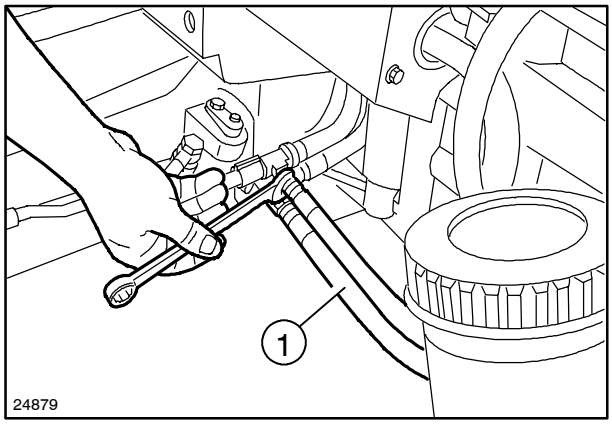
21

19. Disconnect the electrical connections (1) between the cab and the engine.
20. Disconnect the engine oil pressure sensor electrical connection.



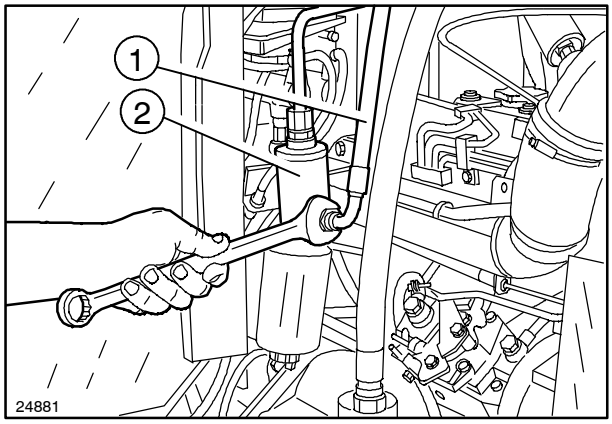
22

21. Detach the rev counter/hourmeter control and remove the clamp from the relative sheath.
22. Disconnect the two power steering oil delivery and return hoses (1).



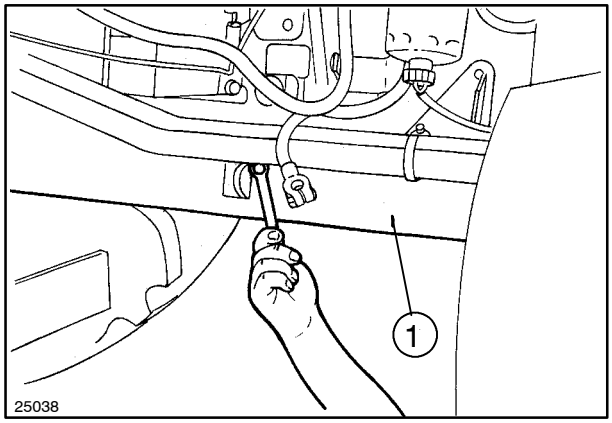
23

23. Disconnect the hose (1) from the anticavitation expansion box (2) located on the power steering unit return line.



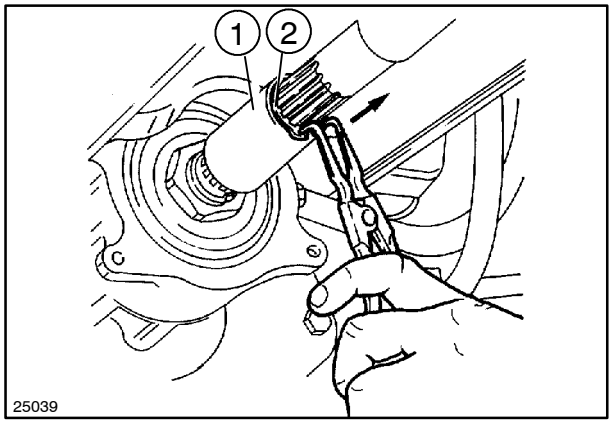
24

24. Unscrew the front central and rear retaining bolts on the front axle shaft guard, then remove the guard (1).



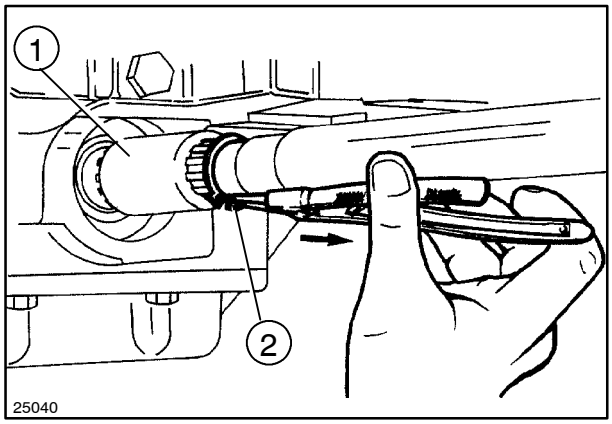
25

25. Remove the circlip (2) and move the sleeve (1) in the direction indicated by the arrow until it is released from the groove on the front axle.



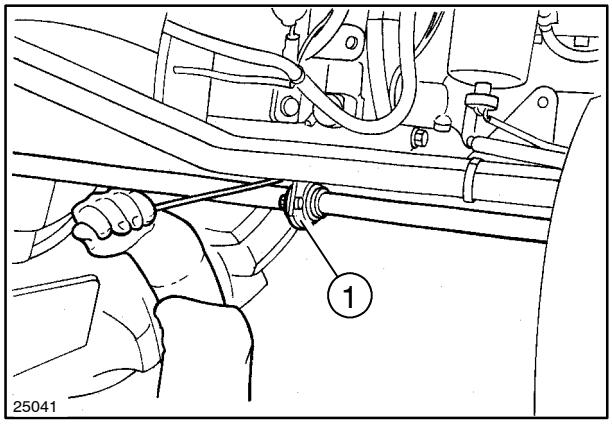
26

26. Remove the circlip (2) and move the sleeve (1) in the direction indicated by the arrow until it is released from the groove on the drive.



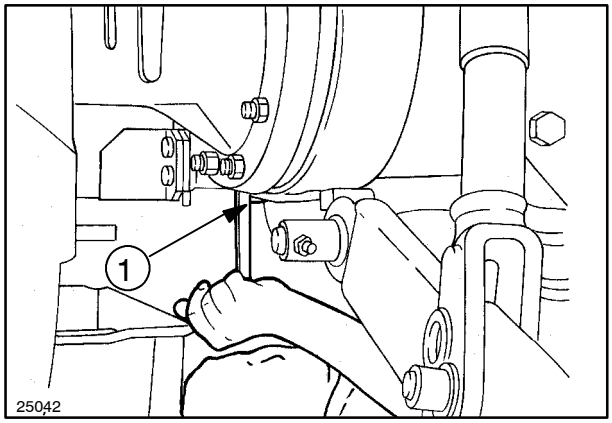
27

27. Remove the drive shaft central support (1) retaining bolts and extract the shaft together with the support.



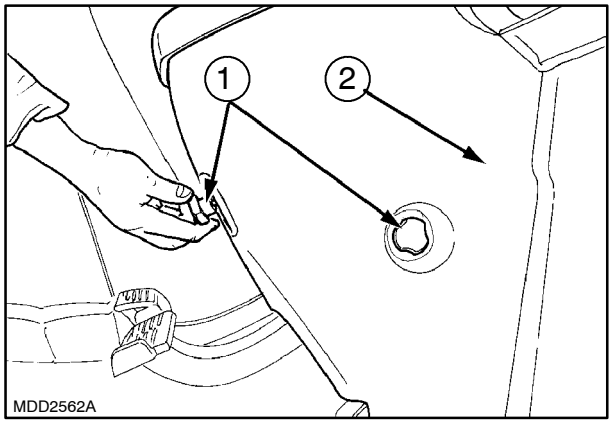
28

28. Detach the 4WD engagement distributor oil delivery line (1).



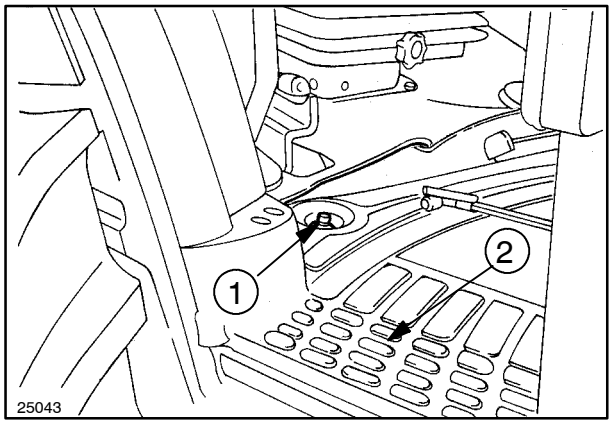
29

29. Remove the four knobs (1) and take off the two dashboard panels (2).



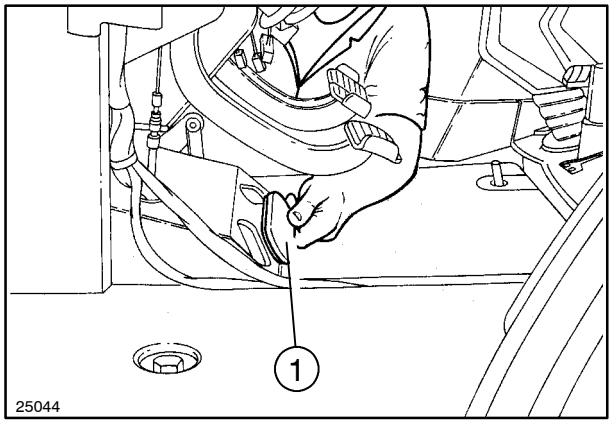
30

30. Extract the differential lock pedal retaining pin from the drive shaft (1), remove the pedal and footboard (2).



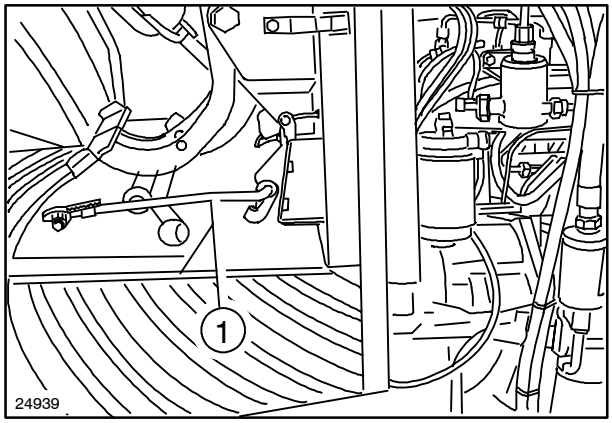
31

31. Remove the footboard and plugs (1) in order to gain access to the engine upper retaining bolts.



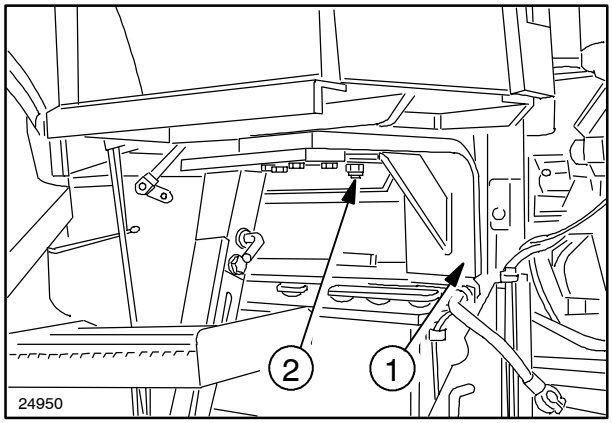
32

32. Detach the accelerator cable from the pedal (1).



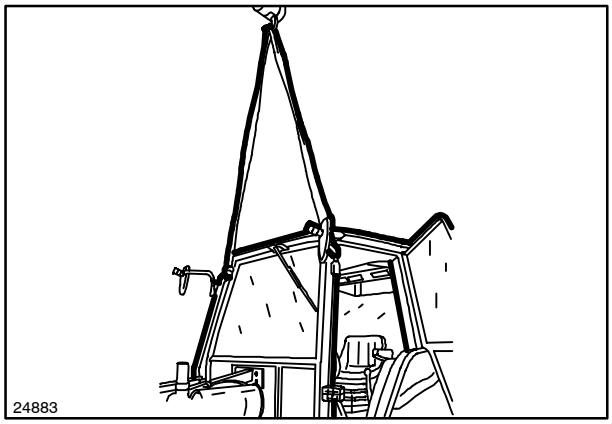
33

33. Remove the two front nuts (2) (one on each side) that secure the cab to the silent-blocks fitted on the supports (1).



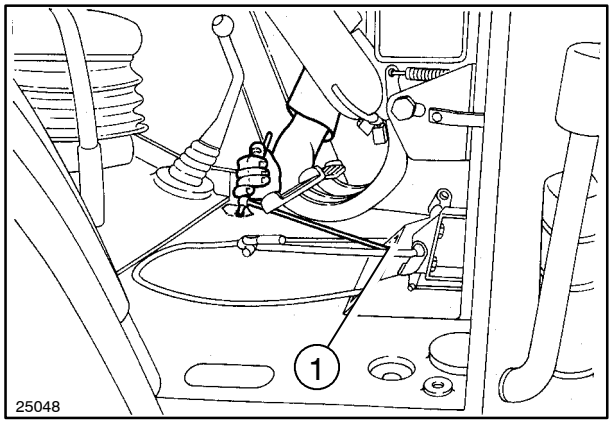
34

34. Raise the cab from the front by approximately 2.362 in. (6 cm).



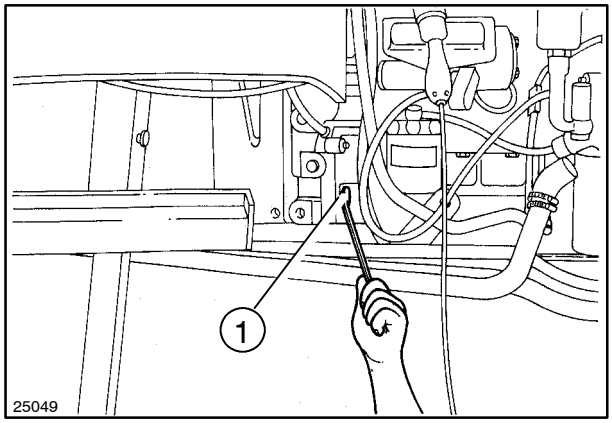
35

35. Unscrew the two nuts and bolts that secure the engine to the transmission, gaining access by means of the two slots (1).



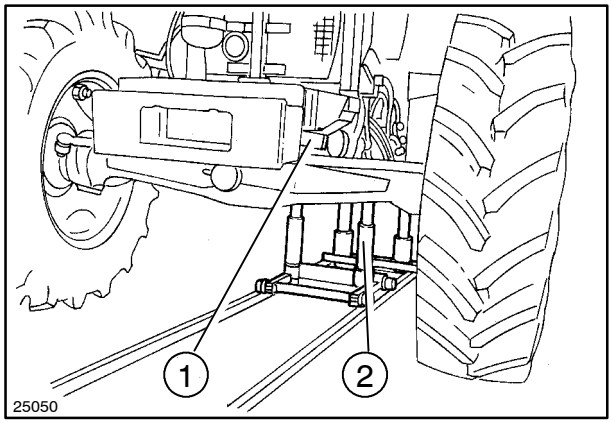
36

36. Unscrew the four lower bolts (1) that secure the engine to the transmission.



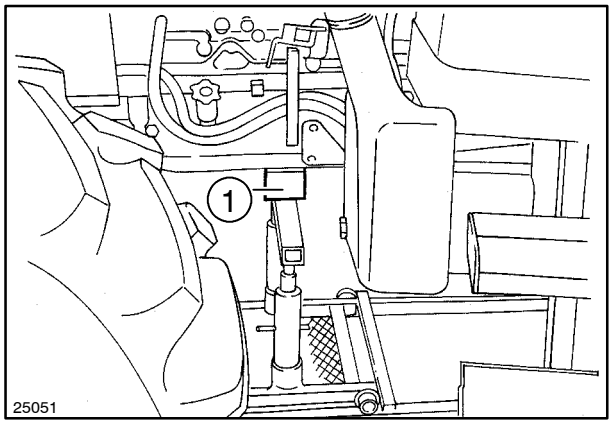
37

37. Position tool **380000236** (2) under the tractor and insert two blocks (1) on the front axle to avoid oscillation.



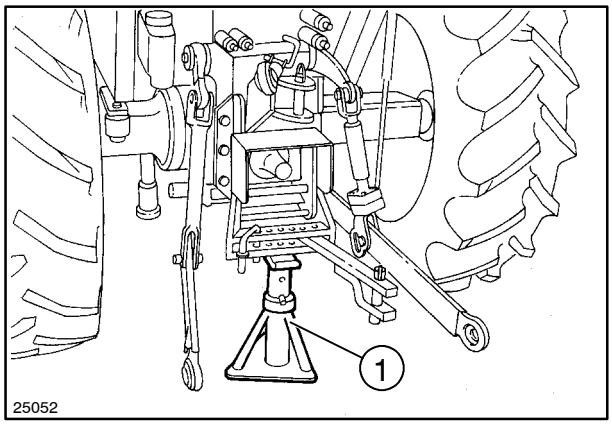
38

38. Position a wooden block (1) at the point where the stand makes contact with the tractor.



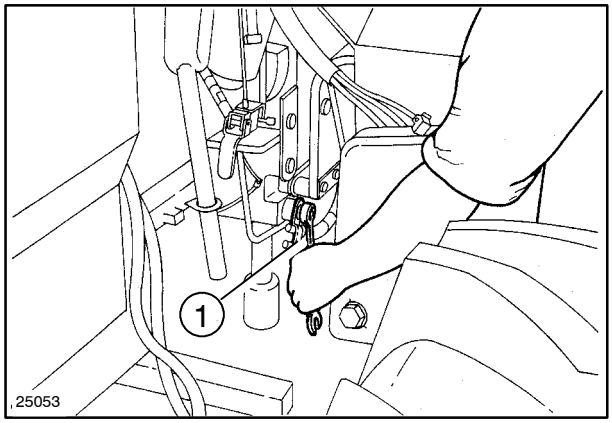
39

39. Position a fixed stand (1) under the towbar and apply the handbrake.



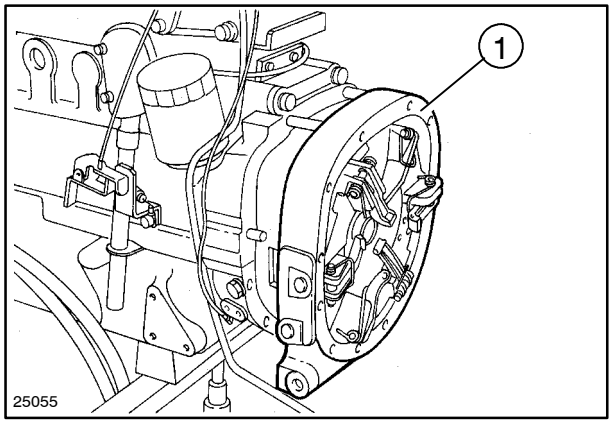
40

40. Detach the cab heating pipes support bracket (1).
41. Unscrew the remaining four engine/transmission retaining bolts.
42. Disconnect the two electrical connectors on the right-hand side of the dashboard.
43. Separate the engine from the transmission.



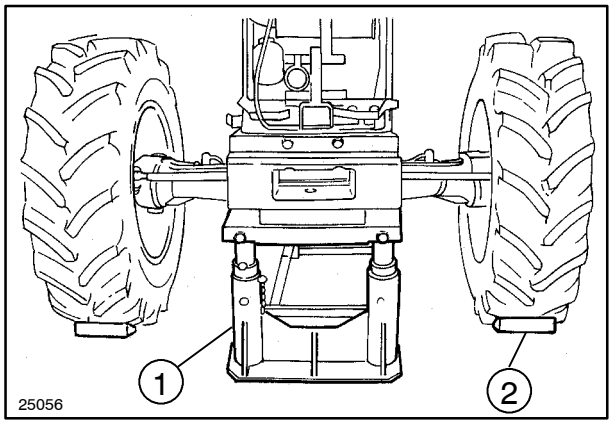
41

44. Remove the spacer (1) located between the engine and the transmission.



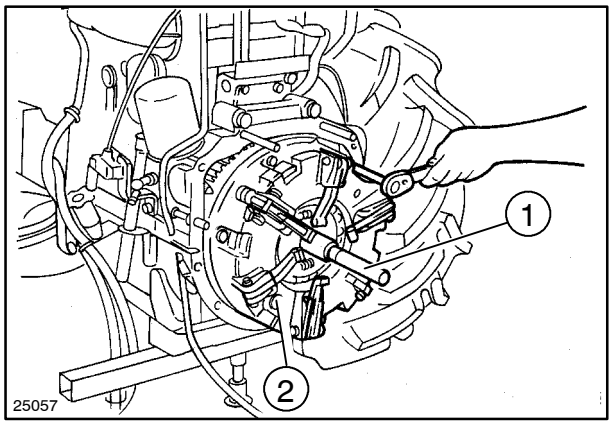
42

45. Position the fixed stand (1) under the ballast support and secure the front wheels with wooden blocks (2).



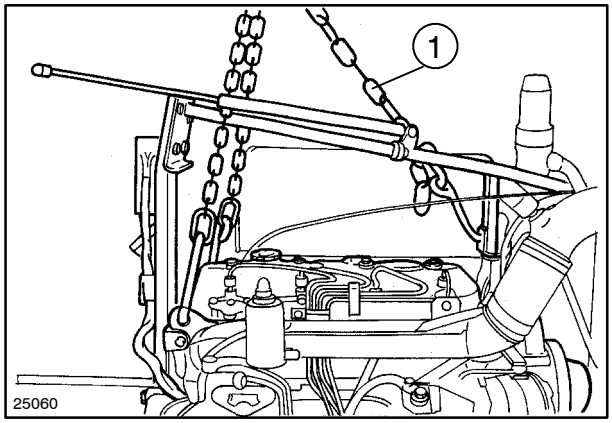
43

46. Insert tool (1) **380000292** in the clutch aperture. Unscrew the six retaining bolts (2) that secure the clutch to the engine flywheel and remove the assembly.



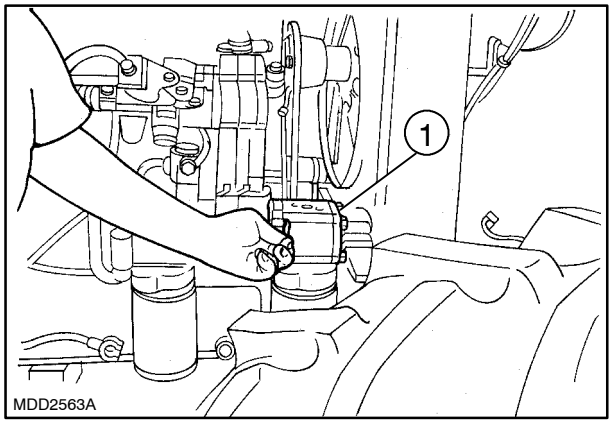
44

47. Remove the radiator bracket retaining screw.
48. Hitch the engine to a hoist using the adjustable chain (1) attached to the engine removal hitch points.



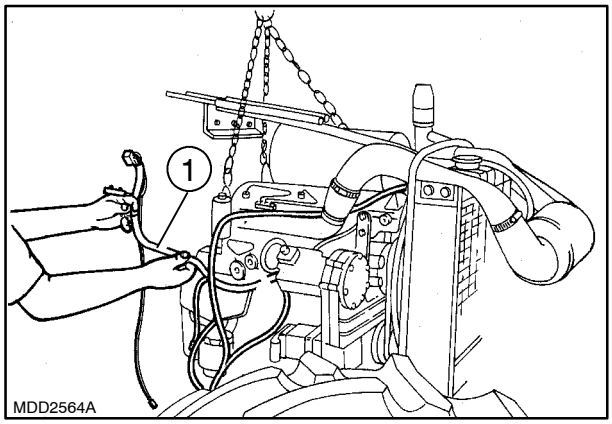
45

49. Remove the lift pump (1) with the relative filter, by unscrewing the four retaining bolts.



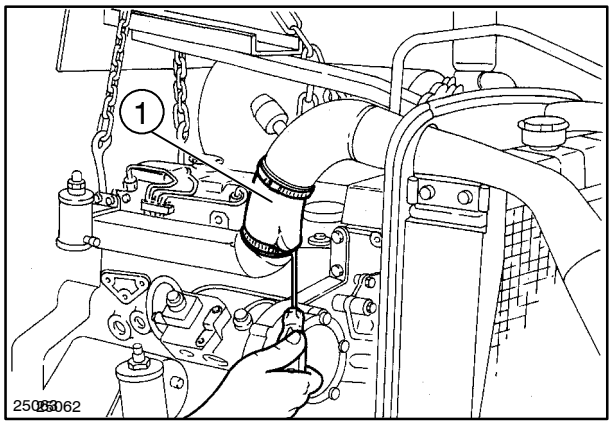
46

50. Disconnect all electrical connections and remove the wiring (1).



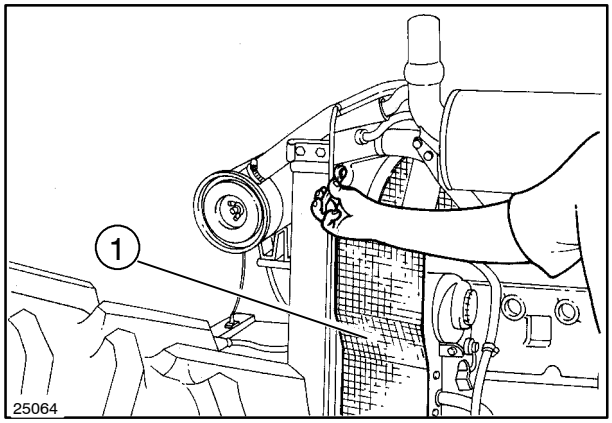
47

51. Loosen the clamp and disconnect the sleeve (1) on the intake manifold.



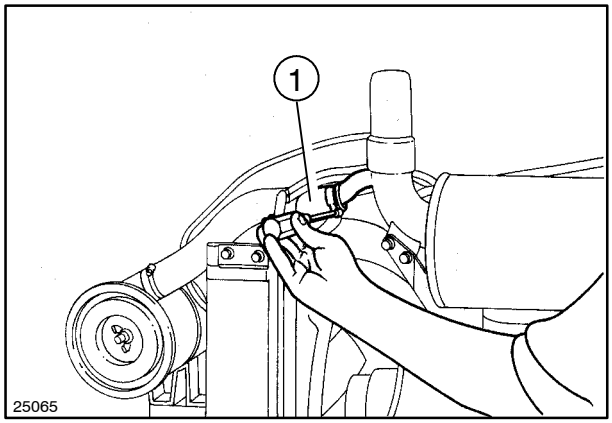
48

52. Remove the fan mesh guard (1) from the left-hand side of the engine.



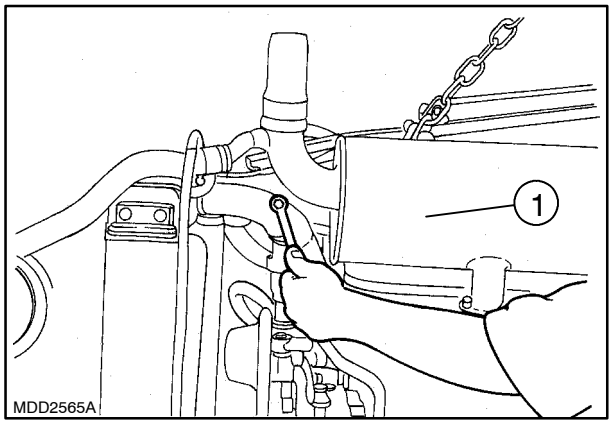
49

53. Remove the clamp and extract the exhaust ejector filter connection (1).



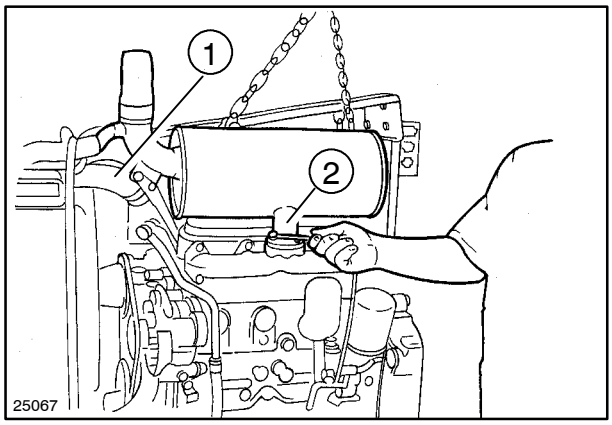
50

54. Remove the exhaust retaining bolts (1) from the support bracket.



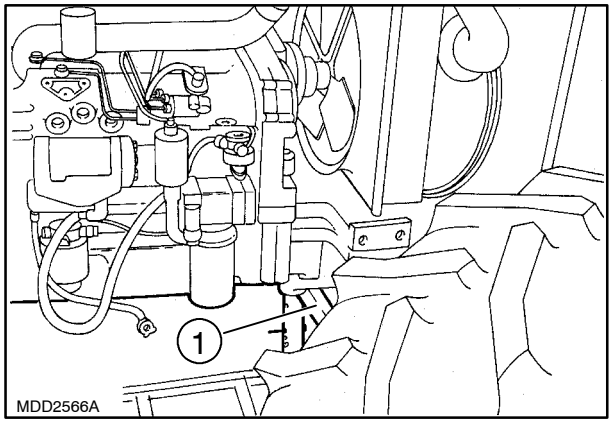
51

55. Remove the clamp and extract the radiator upper sleeve (1).
56. Unscrew the three nuts (2) that secure the silencer to the manifold and remove the unit.



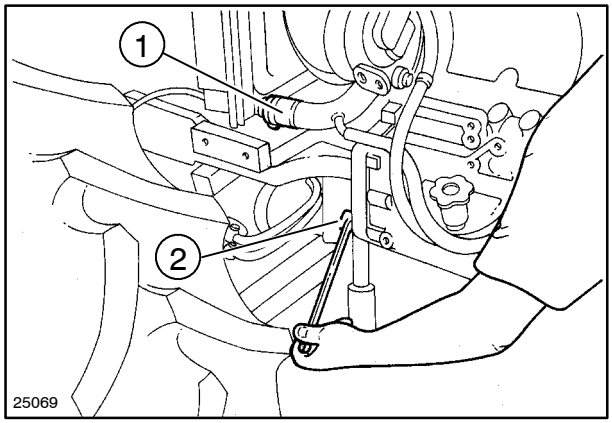
52

57. Slightly raise the engine and position the mobile stand (1) under the front axle support.



53

58. Remove the clamp and extract the radiator lower sleeve (1).
59. Detach the engine from the axle support, unscrewing the four bolts (2) and position on a wooden platform.



54

60. To refit the engine, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Apply the torque settings listed on page 22.
- Sling the engine with an adjustable chain, coupling the three hooks to the three eyes. Raise the unit from the wooden platform and position the engine in front of the front axle support. Unite the two units, securing in position with the four retaining bolts.
- Move the mobile stand from the front axle differential casing to the engine oil sump, inserting the previously shaped wooden block.
- Insert the rubber sleeve in the thermostatic valve unit union. Secure the sleeve with an adjustable clamp.
- Also reconnect the lower hose from the radiator with the union on the coolant pump, using a rubber sleeve, then secure all piping with adjustable metal clamps.
- Refit the lift pump.
- Remove the chain from the engine.
- Insert the air delivery pipe on the intake manifold and secure with the relative clamp.
- Reconnect all electrical connections that were previously disconnected. Thermostarter glow-plug, coolant temperature sensor, clogged air filter sensor, horn, front axle support weight, engine cut-out wire on injection pump, wires on the alternator and relays, engine oil pressure sensor, starter motor connection, fuel dehydration filter. Secure the wiring with plastic wiring clamps.
- Assemble the clutch using pin **380000292**. Secure the clutch to the engine flywheel using the six bolts.
- Fit the 4WD distributor oil delivery line.
- Clean the spacer and the clutch overdrive contact surfaces, also scrape away the old sealing compound from the engine surface.
- Apply LOCTITE sealing compound on the engine/spacer contact surfaces. Fit the spacer on the stud bolts screwed on the engine.
- Also apply LOCTITE sealing compound on the clutch overdrive casing surfaces.
- Remove the fixed stand from under the ballast support. Remove the blocks from under the front wheels.
- Hitch the engine to an adjustable chain using the three eyebolts.
- Position wooden blocks under the rear wheels, make sure that the handbrake is fully applied and that all fixed and mobile stands are safely positioned.
- The following phase requires the participation of two or three mechanics. Approach the front axle/engine unit to the clutch overdrive casing, pushing the front wheels with the aid of a hoist. Take care not to damage the rigid oil priming lines and the 4WD distributor delivery line. Check that none of the cables or wires remain nipped between parts. Move the crankshaft, by turning the cooling fan, to allow the second shaft to engage. Secure the two units with a few bolts.
- Detach the chain from the engine. Connect the two hooks hitched to the cab handrail to the hook on the hoist. Raise the front part of the cab by 2.362 in. (6 cm).
- Tighten all the engine/clutch overdrive casing retaining bolts.
- Tighten the brake line support bracket on the right-hand side. Lower the hoist, disconnect the chains from the handrail.
- Lower the stands from under the engine oil sump and clutch casing. Remove tool **380000236** and the stand from under the traction bar support.
- Lock the cab in position with the two front bolts.

- Connect the hose to the injectors excess fuel line. Reconnect the pipe on the thermostart glow-plug and the dehydrator filter.

- Refit the fuel filter support securing to the engine body. Connect the two semi-rigid pipes on the support.

- Connect the two power steering distributor oil delivery and return lines to the anticavitation expansion box.

- Refit the oil priming lines on the pumps and secure the rubber sleeves with clamps.

- Refit the lift distributor oil delivery line on the relative pump. Remember to fit the O-ring.

- Secure the three lines with adjustable metal clamps.

- Reconnect all the electrical connections on the vertical bracket.

- Refit the cab heating pipes on the engine/clutch casing spacer. Connect the rubber hoses to the union.

- Connect the two power steering hoses to the union located on the left-hand side of the front axle. Secure the hoses with a special clamp, and screw the clamp to the tractor body.

- Refit the rev counter/hourmeter and secure the sheath with the relative clamp.

- Fit the silencer on the exhaust manifold, together with the gas seal. Secure the front part of the silencer to the support bracket and insert the exhaust ejector filter connecting hose.

- Secure the bonnet support bracket to the radiator bracket.

- Reconnect the 4WD distributor oil delivery line and the rear differential lock.

- Refit the 4WD shaft and the guard.

- Reconnect the accelerator cable to the pedal. In our case an adjustment was required to the wire connected to the lever on the injection pump (adjustment time: approx. 6 minutes).

- Fit the clutch wire on the pedal. Secure the sheath on the stop bracket.

- Refit the plastic plugs in the slots on the cab flooring. Reposition the foot mat.

- Refit the steering column panels.

- Refit the lateral fan guards.

- Hitch the bonnet using the same method described in the disassembly operations. Secure the bonnet hinge to the relative support bracket. Reconnect the bonnet raise/lower pneumatic pistons and the headlights connections, then remove the hitching sling.

- Refit the secondary bracket (battery support) to the clutch overdrive casing. Fit the rotating bracket with the battery on the fixed bracket.

- Refit the front ballast, secure with the vertical pin.

- Refit the support bracket and fit the toolbox on the bracket.

- Refill the transmission casing with the oil that was previously removed.

- Fill the radiator with coolant.

- Connect the positive and negative cables to the correct poles. Cover the battery with the plastic cover.

Op. 10 001 30
COMPRESSION TEST

In case of poor engine performance, in addition to checking the fuel injection system (injection nozzles and injection pump), also test the compression on each cylinder.

DANGER

Do not use matches, lighters, blowtorches or any form of naked flame as a source of light when inspecting the engine due to the presence of inflammable fluids and vapour.

Compression ratio

The compression ratio is a measure of the quantity of air drawn into the cylinder, and provides an indication of the efficiency of the sealing elements in the cylinder (piston rings and valves).

Uniform compression in all the cylinders ensures that they all perform an equal amount of work, provided that each cylinder is injected with the same quantity of fuel at the right time.

Low compression not only reduces engine performance, it also causes incomplete fuel combustion due to the lack of available combustion air.

The engine therefore gives poor performance with excessive fuel consumption and, consequently, exhaust smoke and restriction of the exhaust passages.

As the compression ratio **also varies with the temperature of the engine** (cold engines produce lower compression values than hot engines), the compression should only be tested when the engine is at normal operating temperature.

Compression should be tested using the compression test kit **380000303**, as follows:

1) run the engine until it reaches normal operating temperature;

2) switch off the engine;

3) disconnect the lead from the engine stop electromagnet on the injection pump in order to close the valve and block the flow of fuel to the injectors;

4) remove the injector from the cylinder to be tested;

5) turn the engine over a few times with the starter motor in order to expel any carbon residue;

6) fit the dummy injector **293862** (included in kit **380000303**) in place of the injector removed previously, interposing the copper sealing washer;

7) connect the compression test instrument **380000303** and take readings while turning the engine over with the starter motor.

On engines in perfect working order, with the sump oil at approx. 104 °F (40 °C) at sea level 29.9 in. (760 mm mercury) and at an engine speed of 200 to 280 rpm, the compression should be 369.8 to 398.8 psi (25.5 to 27.5 bar).

8) Test the compression on the other cylinders, repeating steps 4–5–6–7, bearing in mind that:

The minimum permissible compression on a used engine is 313.2 psi (21.6 bar).

The maximum permissible compression difference between cylinders is 43.5 psi (3 bar).

Every 328 feet (100 metres) above sea level corresponds to a reduction in compression by approx. 1%.

CONSIDERATIONS:

Uniform compression

Although high compression is important, it is more important for smooth engine running that compression is uniform in all cylinders.

Low compression readings

If extremely low pressure readings are obtained on one cylinder it is advisable to repeat the test.

Before testing this time, pour about a spoonful of engine oil into the cylinder through the injector bore.

Turn over the engine a few times to distribute the oil evenly over the cylinder walls, and then repeat the test.

If the second test readings are significantly higher, suspect worn piston rings, out–of–round or damaged pistons or liners.

If the second test readings are not higher, the problem will be the valves.

On the other hand, if the second test reading shows only a slight improvement, the problem will be due to both the valves and the rings.

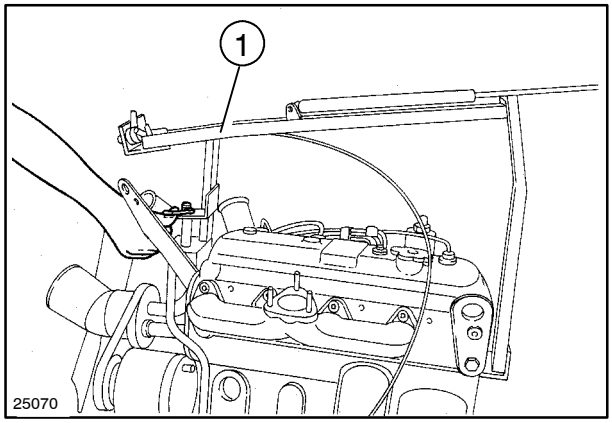
Op. 10 001 53
ENGINE D.A.

CAUTION

Handle all parts carefully.

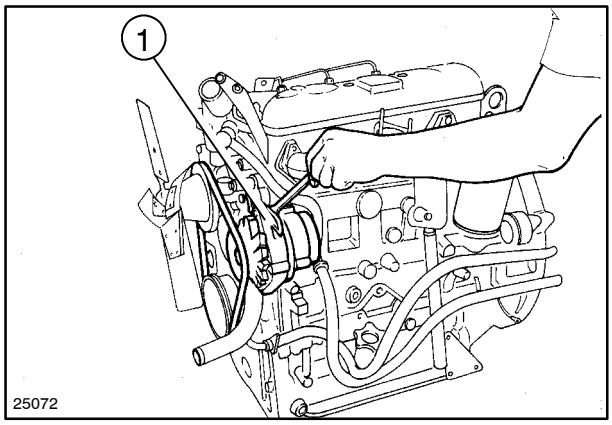
Do not put your hands or fingers between parts. Wear suitable safety clothing – safety goggles, gloves and shoes.

1. Remove the bonnet support bracket (1) front and rear retaining bolts.



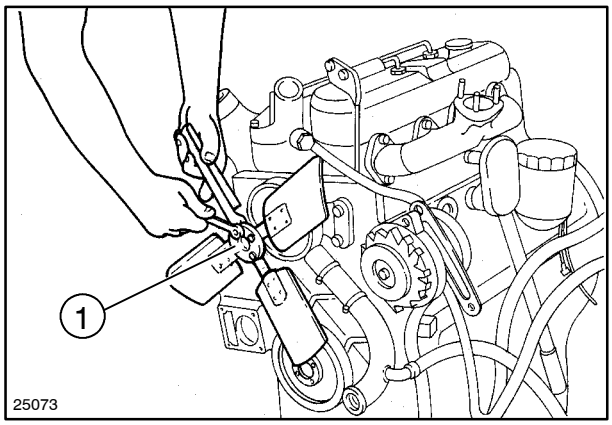
55

2. Loosen the alternator lower retaining bolt.
3. Loosen the belt tension adjustment bolt (1).
4. Release the belt adjustment bracket by re–moving the retaining nut.
5. Remove the alternator belt and coolant pump.



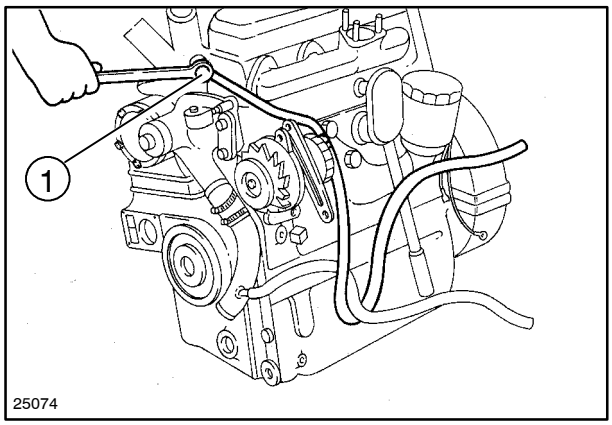
56

6. Unscrew the fan and pulley/coolant pump retaining bolts (1) and remove the two parts.



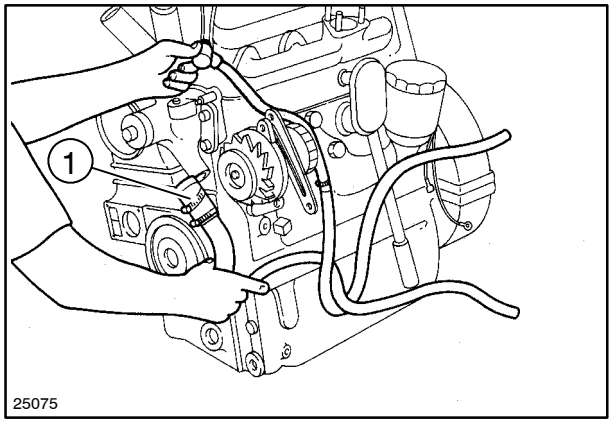
57

7. Unscrew the union (1) on the cab heating delivery piping.



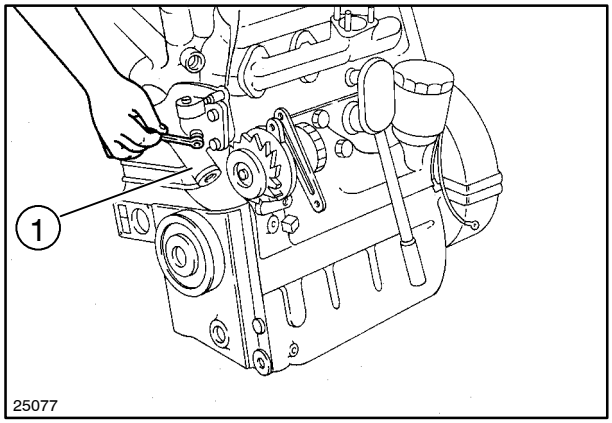
58

8. Loosen the clamp, extract the sleeve (1) from the coolant pump and remove the cab heating curved pipe and hoses.



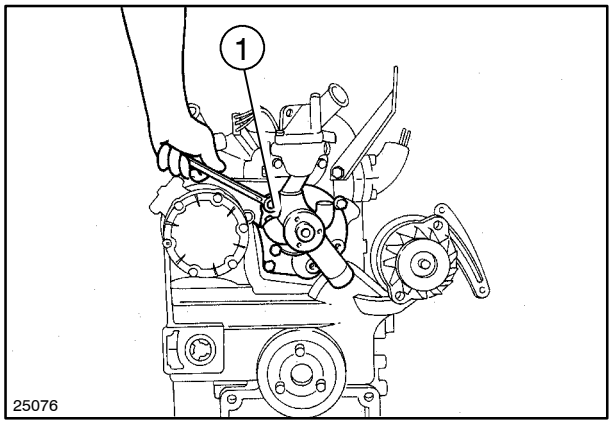
59

9. Remove the union (1) to access the pump retaining bolt.



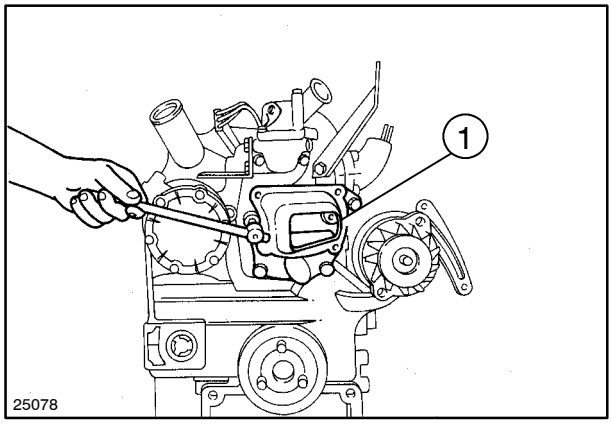
60

10. Unscrew the coolant pump retaining bolts (1) and remove the assembly.



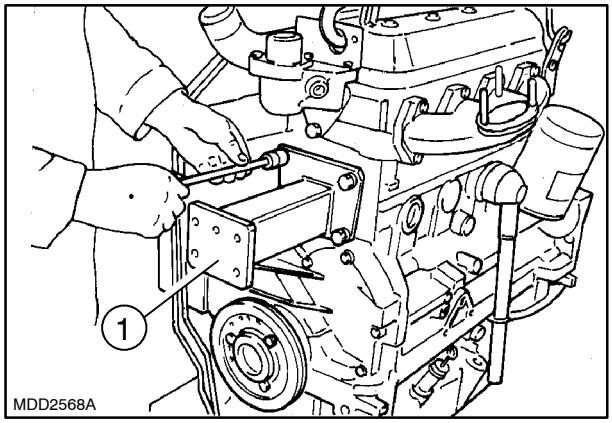
61

11. Unscrew the pump support retaining bolts (1), the silencer support and remove the parts.



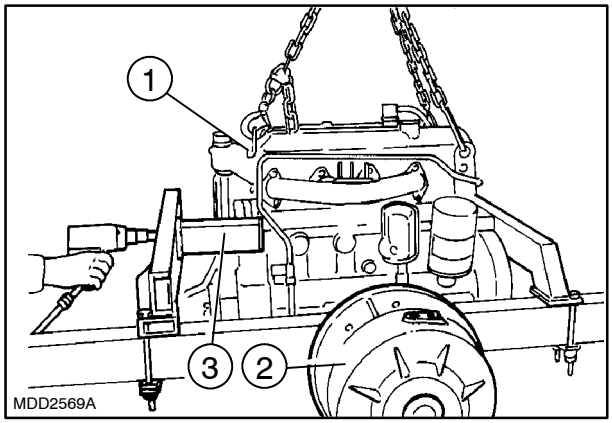
62

12. Fit bracket (1) of series **380000313** to secure the engine to the rotating stand **380000301**.



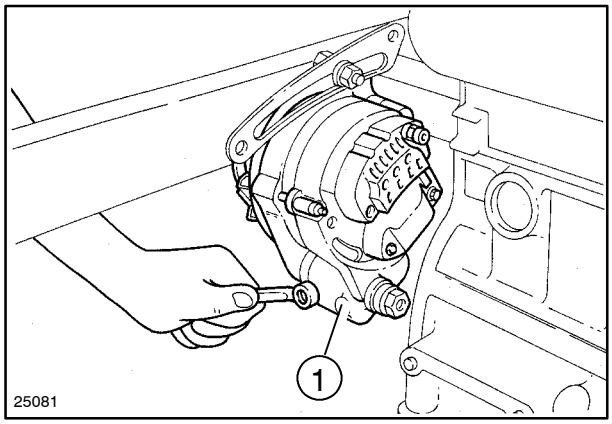
63

13. Fit an eye hook (1) on the front part of the engine on the silencer support bracket position.
14. Raise the engine from the wooden platform then position and secure on the rotating stand **380000301** (2) using bracket (3) of series **380000313**.



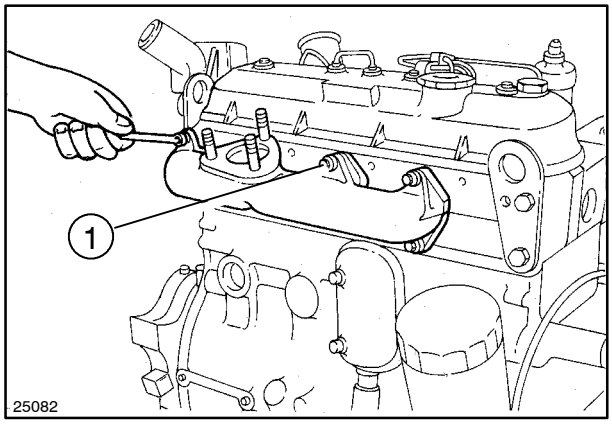
64

15. Unscrew the alternator support retaining bolts (1) from the base and remove the complete unit.



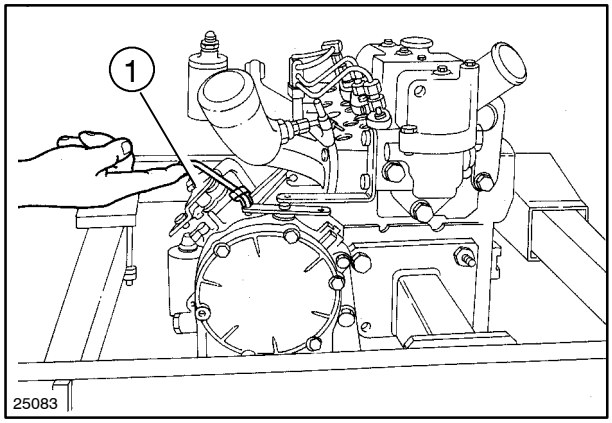
65

16. Unscrew the exhaust manifold/cylinder head retaining bolts (1) and remove the part.



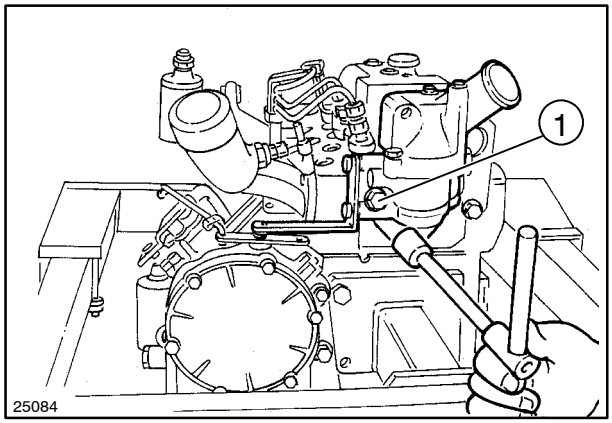
66

17. Disconnect the accelerator lever (1) from the injection pump.



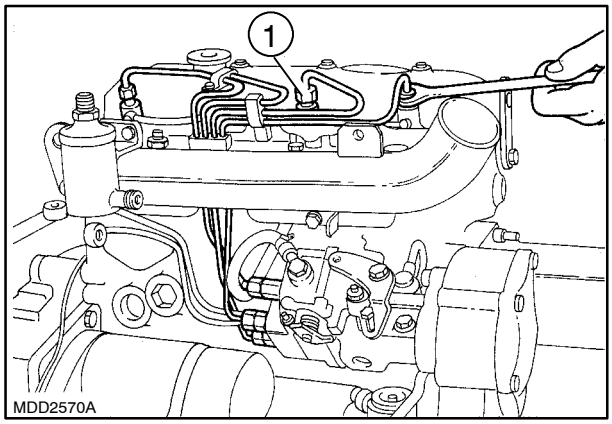
67

18. Unscrew the thermostat support retaining bolts (1) and remove the unit.



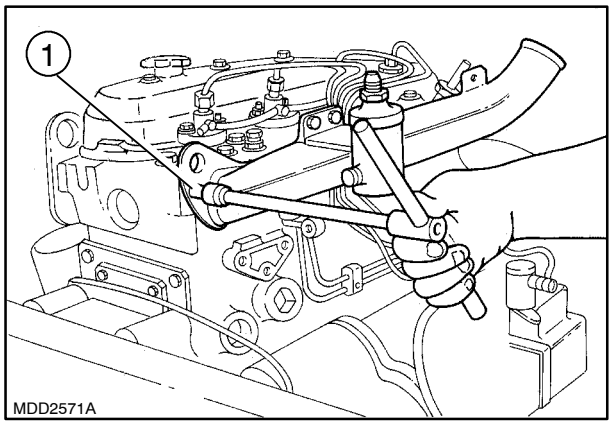
68

19. Unscrew the unions (1) that connect the injection pump/injectors lines and remove the piping.



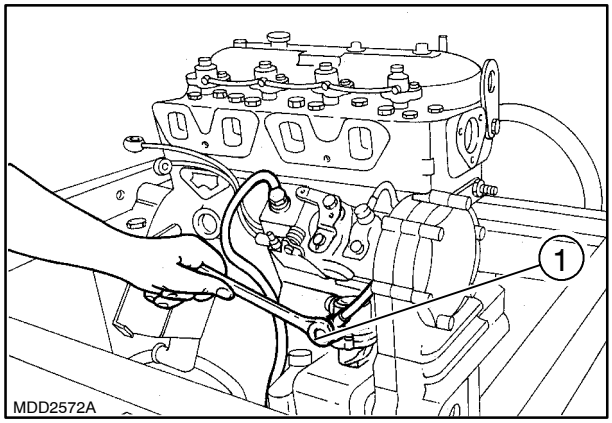
69

20. Unscrew the intake manifold/cylinder head retaining bolts (1) and remove the part.



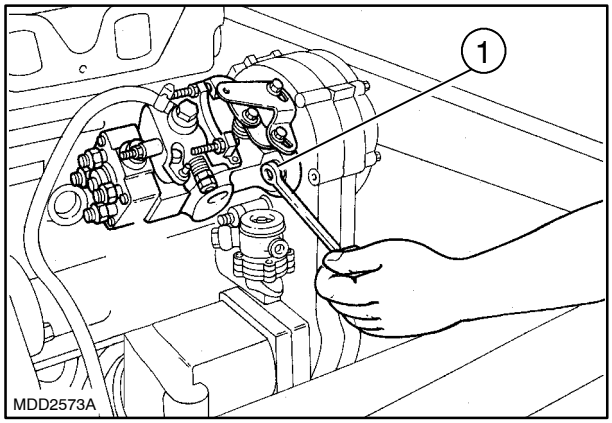
70

21. Unscrew the unions (1) on the fuel pump and remove the piping.



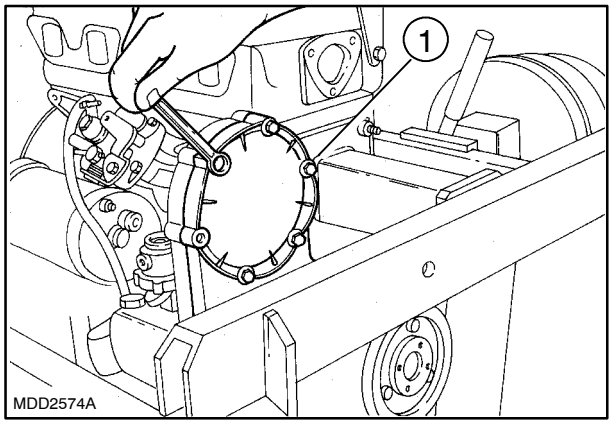
71

22. Unscrew the injection pump retaining nuts (1) from the distribution casing.



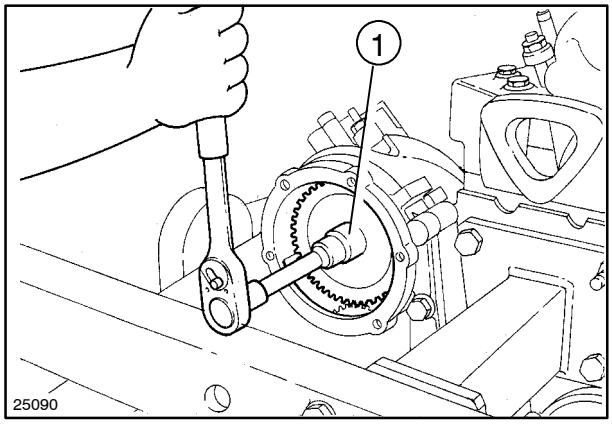
72

23. Unscrew the bolts (1) and remove the injection pump gearing access cover.



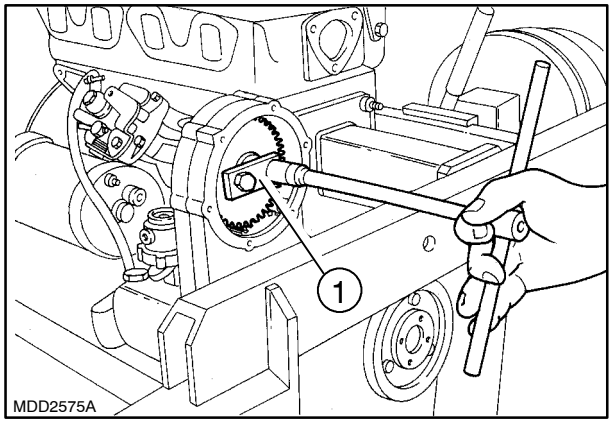
73

24. Unscrew the injection pump locknut (1) on the relative gearing.



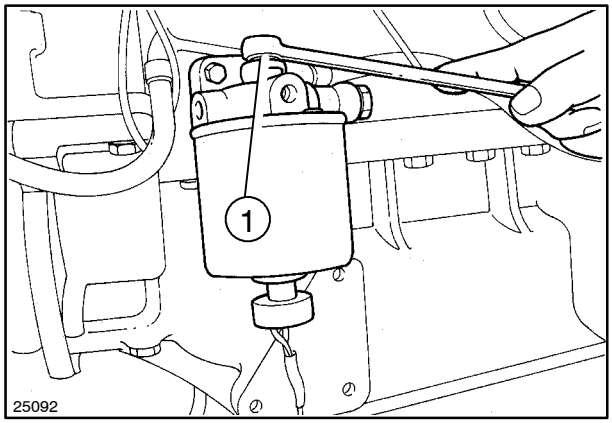
74

25. Extract the injection pump gearing using tool **380000322** (1) and remove the injection pump and relative Woodruff key.



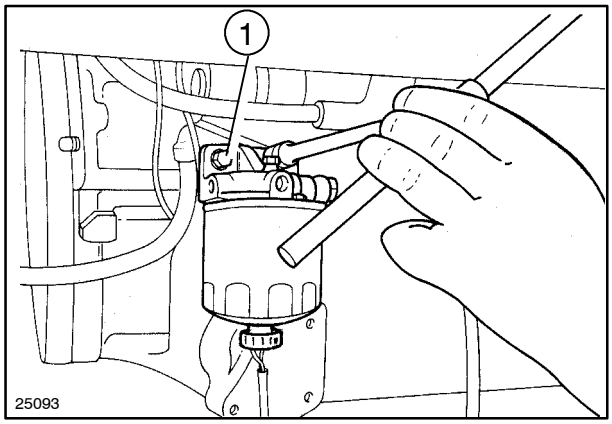
75

26. Unscrew the unions (1) on the fuel lines to the sediment filter.



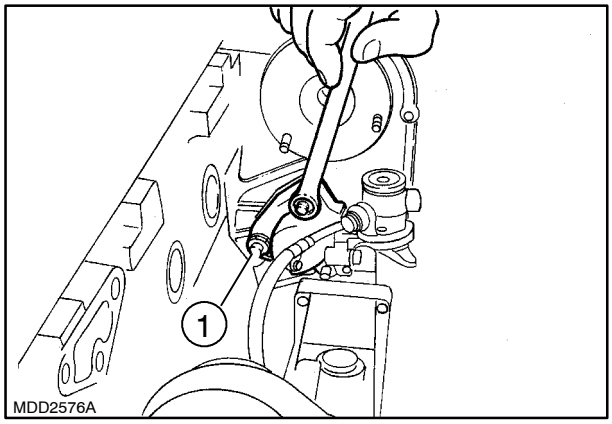
76

27. Unscrew the retaining bolts (1) on the sediment filter/engine block and remove the complete filter unit.



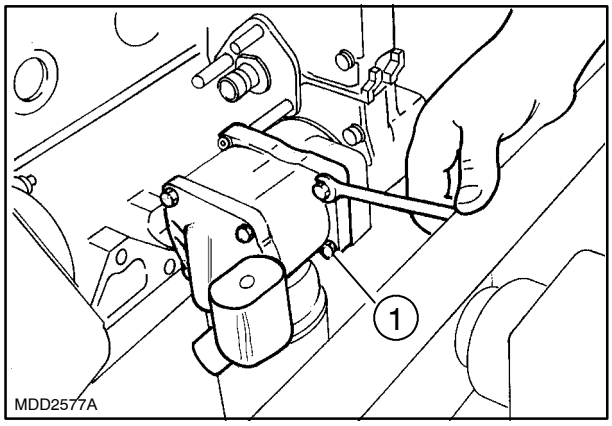
77

28. Unscrew the retaining nuts (1), disassemble the fuel pump support, complete with the pump, and remove the mating seal.



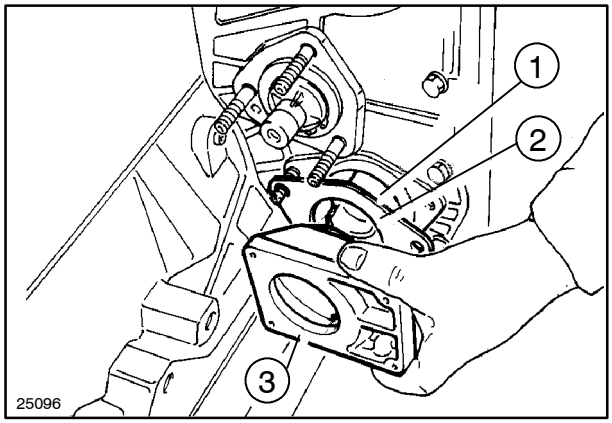
78

29. Unscrew the retaining bolts (1), remove the power steering pump, filter and delivery line.



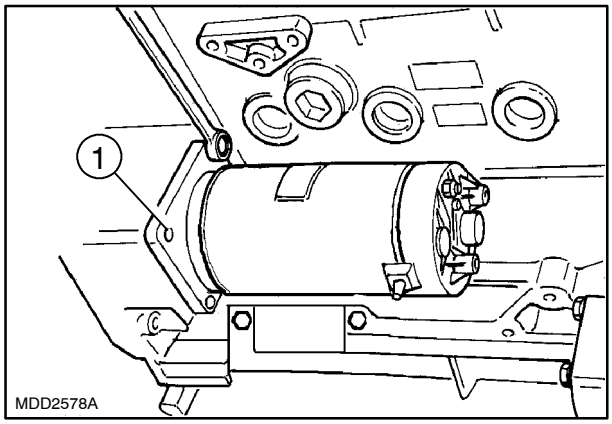
79

30. Remove the spacer (3), seal (2) and drive transmission coupling (1).



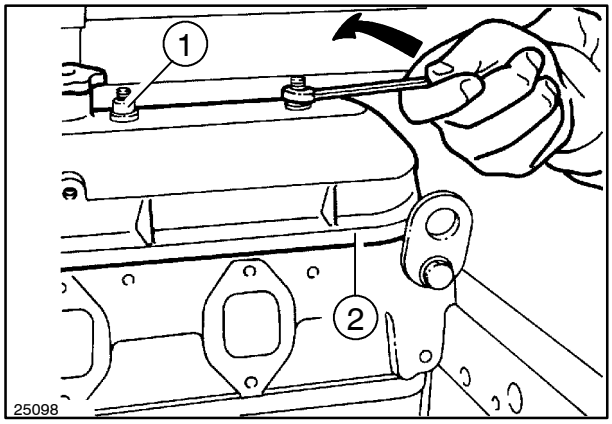
80

31. Unscrew the retaining bolts (1) and remove the starter motor.



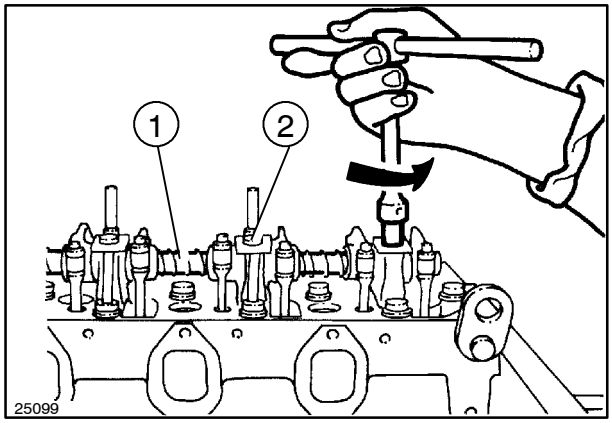
81

32. Remove the injector mounting nuts, the underlying spherical washers, then the supports and the injectors themselves.
33. Remove the retaining bolts (1), washers and seal, then remove the rocker housing cover (2) and seal.



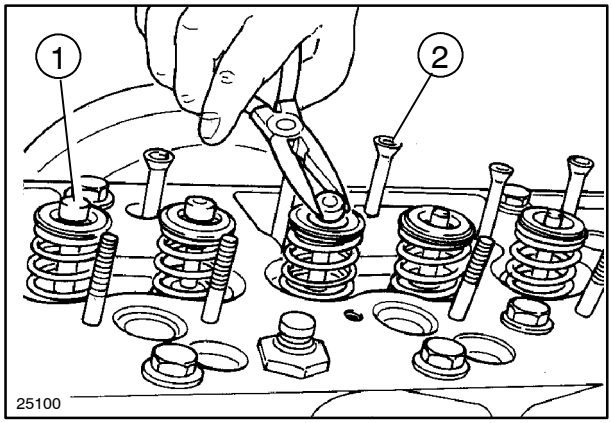
82

34. Remove the rocker shaft retaining bolts (2), then remove the entire rocker shaft assembly (1).



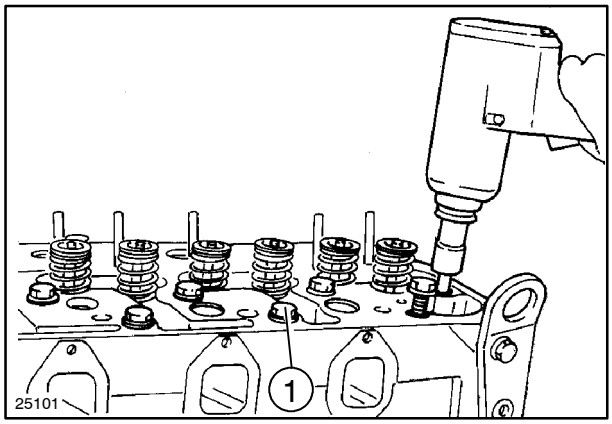
83

35. Remove the valve collets (1) and extract the pushrods (2).



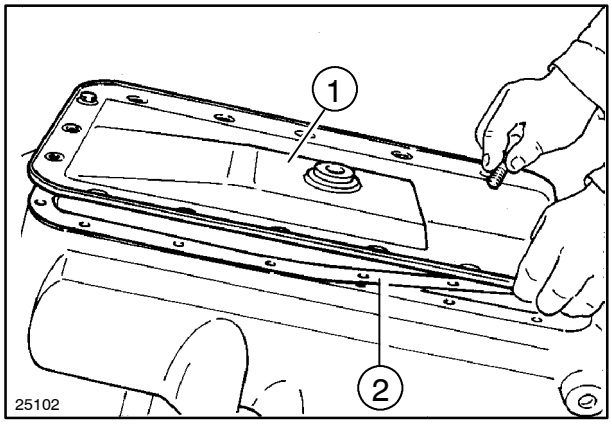
84

36. Unscrew the cylinder head bolts (1) and remove the head using a hoist and lifting hook **380000216**.
37. Remove the cylinder head gasket.



85

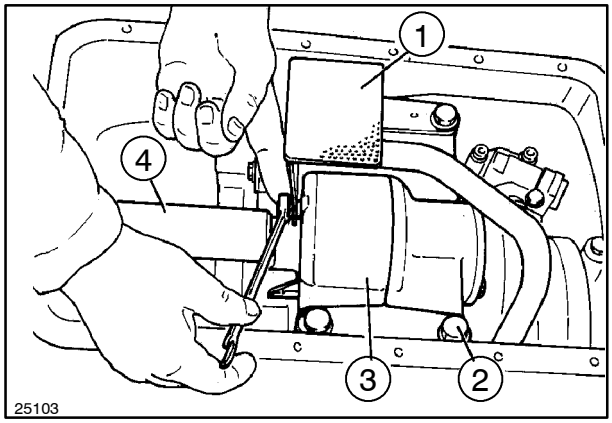
38. Turn the rotating stand through 180°, remove the retaining bolts, the sump cover (1) and seal (2).



86

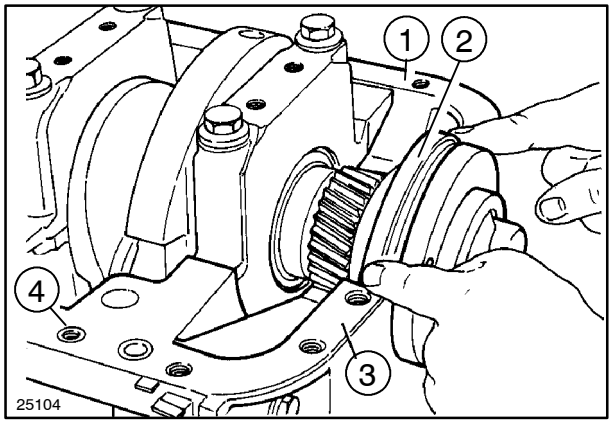
39. Remove the retaining bolts and the engine oil intake piping (1), together with the rose pipe and seal.
40. Remove the retaining bolts (2), and release the rotating counterweight casing (3), remove the sleeve (4) and the casing (3).

NOTE: *To Disassemble/Assemble the rotating counterweight unit, see pages 63-64.*



87

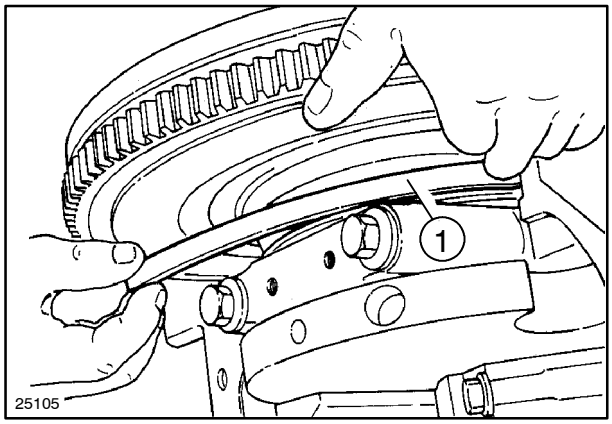
41. Unscrew the sump pan retaining bolts (4) and remove the sump pan using a hoist, lifting hook **380000216** and lifting chain with eyeholes.
42. Remove the half-gaskets (1) and (3) between the crankcase/sump pan and the gasket (2) between the timing gear carrier/sump pan.



88

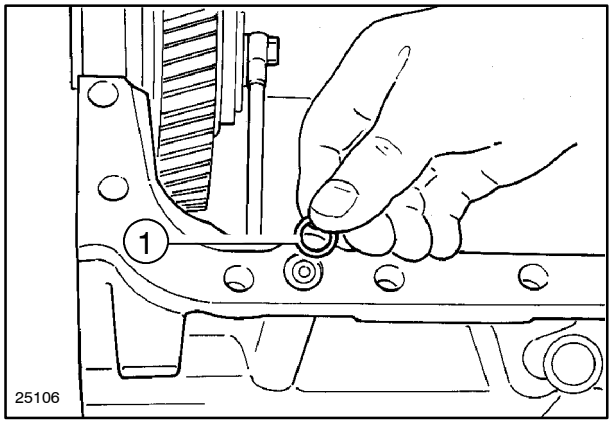
43. Remove the gasket (1) between the flywheel carrier and the sump pan.

NOTE: *When fitting seals (1, fig. 89) and (2, fig. 88), apply RHODORSIL CAF1 silicone sealing compound to the mating surfaces.*



89

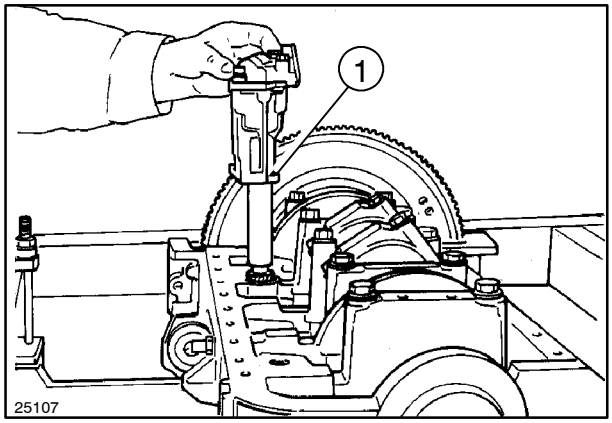
44. Remove the rotating counterweight oil seal O-ring (1) installed on the crankcase mating surface.



90

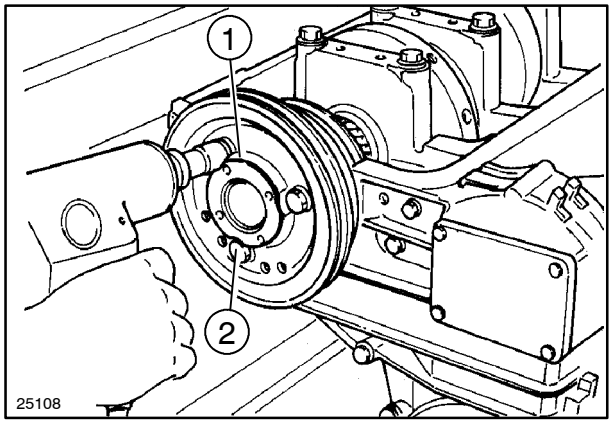
45. Unscrew the retaining bolts (1) and remove the complete oil pump.

NOTE: *For models TL90 and TL100, see Fig. 108.*



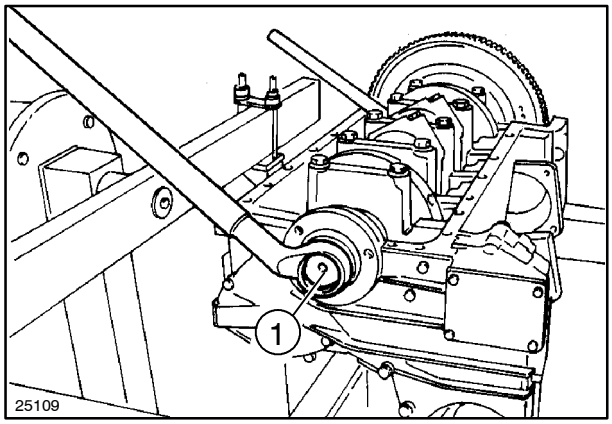
91

46. Unscrew the retaining bolts (2) and remove the fan-alternator drive pulley (1).



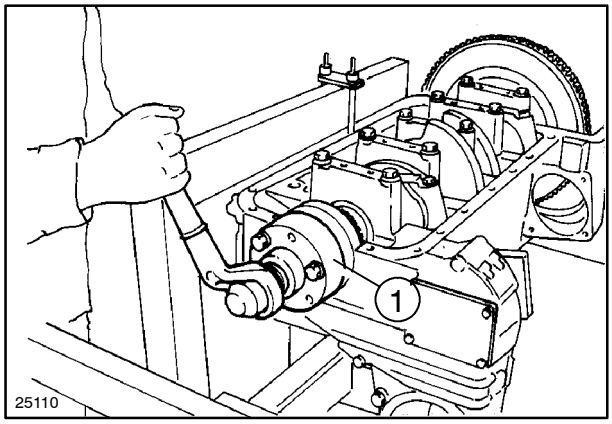
92

47. Straighten the lock tab and remove the nut (1), securing the crankshaft against rotation.



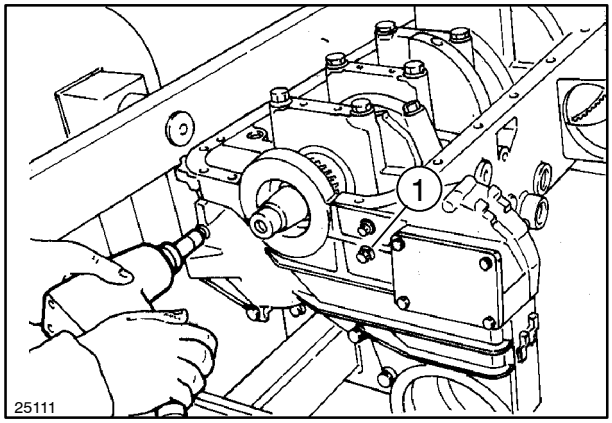
93

48. Pull the pulley hub off the crankshaft using tool **380000226** (1) and recover the Woodruff key.



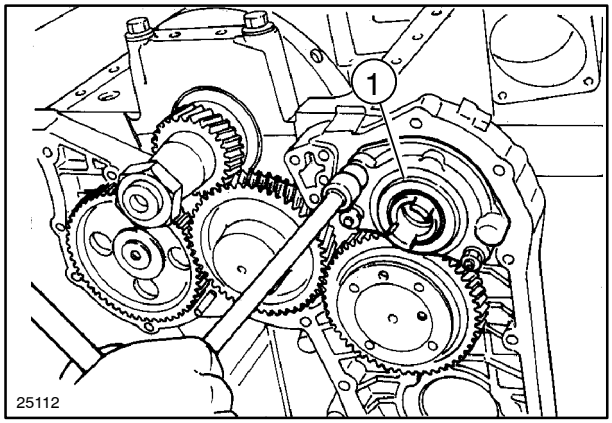
94

49. Unscrew the retaining bolts (1) and remove the timing cover and gasket.



95

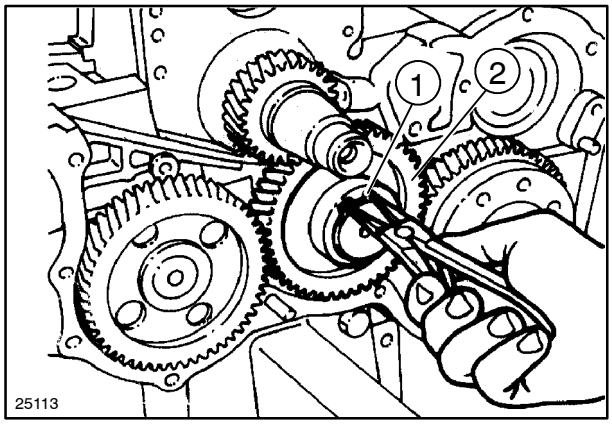
50. Unscrew the retaining bolts and remove the lift pump drive gear carrier (1).



96

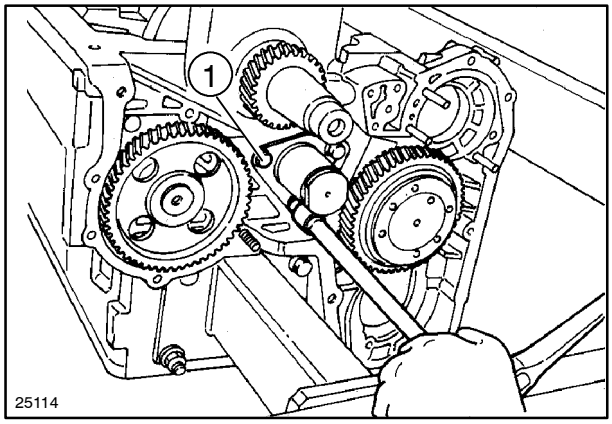
51. Remove the circlip (1) and recover the thrust washer and the intermediate gear (2):

NOTE: *When refitting the intermediate gear see engine timing instructions on page 69.*



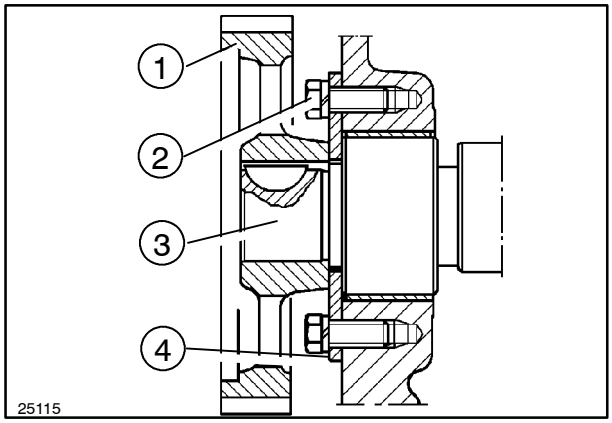
97

52. Unscrew the retaining bolts (1) and remove the intermediate gear journal.



98

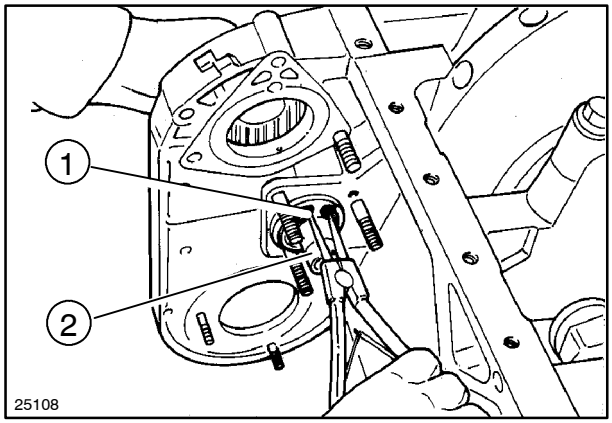
53. Unscrew the retaining bolts (2) and extract the camshaft (3) with the drive gear (1) and the retaining plate (4).



99

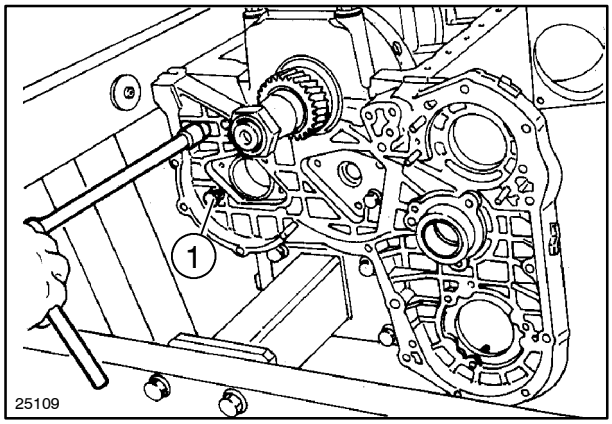
54. Remove the circlip (1) and thrust washer, extracting the gear unit with the fuel pump camshaft (2).

NOTE: *This gear transmits drive to the injection pump gear.*
On re-assembly, see the timing instructions on page 69.



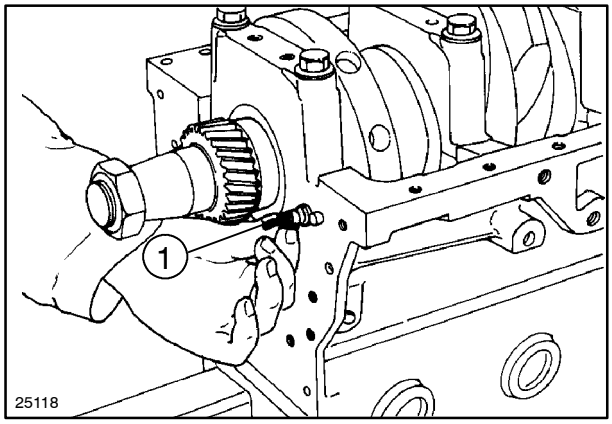
100

55. Unscrew the retaining bolts (1) and remove the timing gear case.



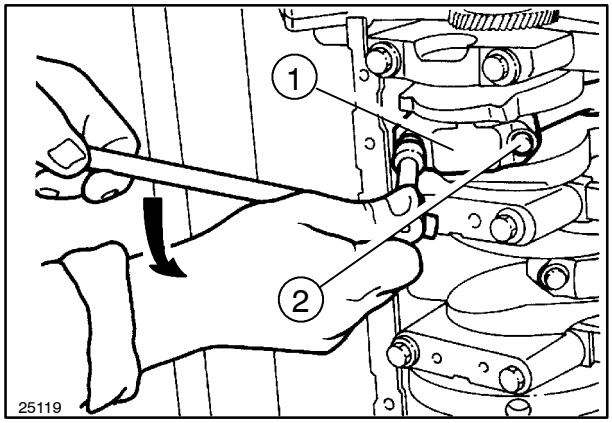
101

56. Replace the O-ring seal (1) installed in the lift pump drive shaft lubrication line.
57. Remove the crankcase - timing gear case gasket.



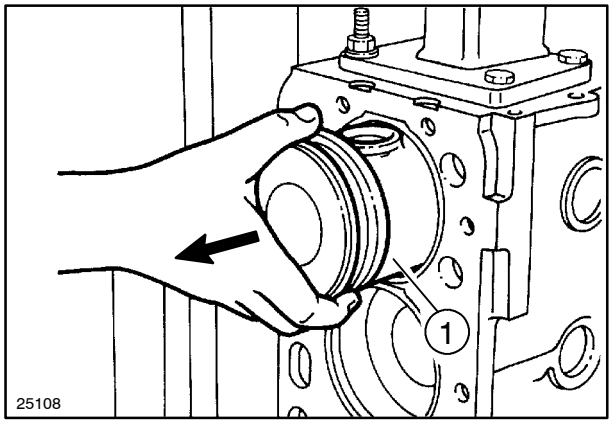
102

58. Rotate the engine through 90°, take out the retaining bolts (2) and recover the big-end caps (1) with their bearings.



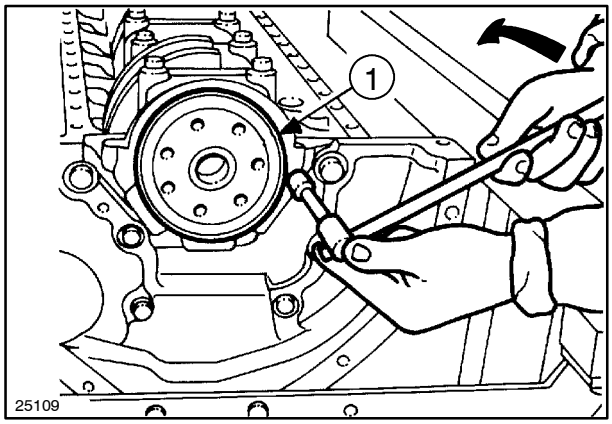
103

59. Slide the pistons (1), complete with rings, gudgeon pins and connecting rods, out of the cylinder linings.



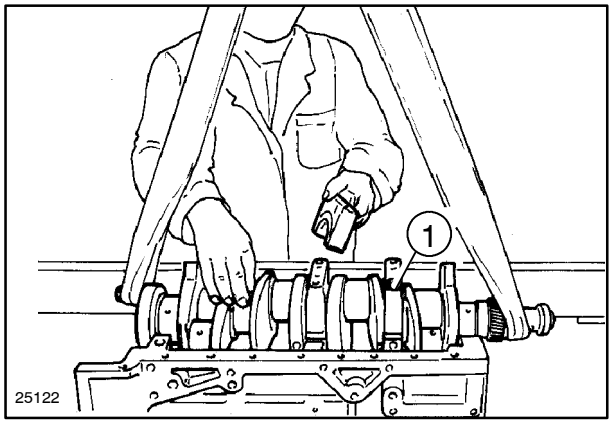
104

60. Return the engine to the horizontal position, rotating through 90° on the stand, remove the retaining bolts and recover the flywheel using the hoist and hook **380000216**.
61. Unscrew the retaining bolts and remove the rear cover (1) complete with gasket.



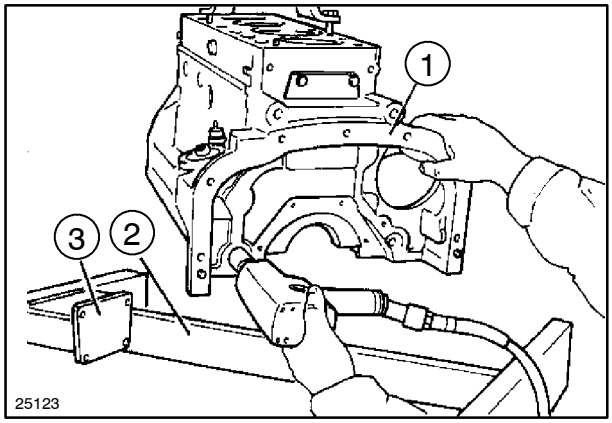
105

62. Unscrew the main bearing cap bolts (1), and remove the main bearing caps with relative bearing shells, recover the thrust washers located on the penultimate main bearing, as shown in the drawing.
63. Lift the crankshaft clear of the crankcase using a hoist and nylon sling. Recover the bearing shells, thrust washers and tappets.



106

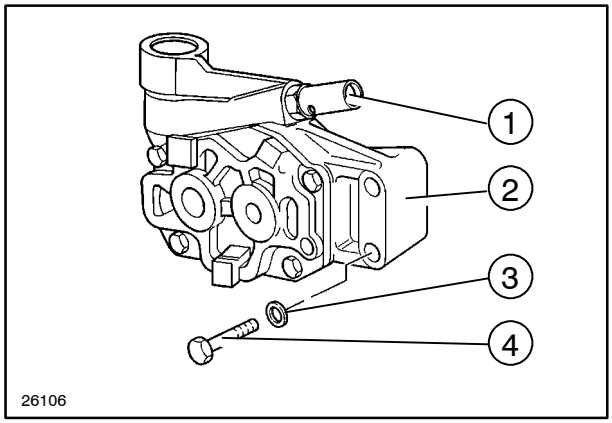
64. Turn the engine through 180° on rotating stand **380000301** (2). Attach the lifting chain with eye-holes to the crankcase, as shown in the figure. Slightly tension the chain with the hoist and the hook **380000216**, take out the bolts securing the crankcase to the rotating stand (2) and bracket (3) of the **380000313** series.
65. Lift the engine clear of the stand.
66. Unscrew the retaining bolts and remove the rear crankcase housing (1) and its gasket.



107

NOTE: *Oil pump on models TL90 and TL100.*

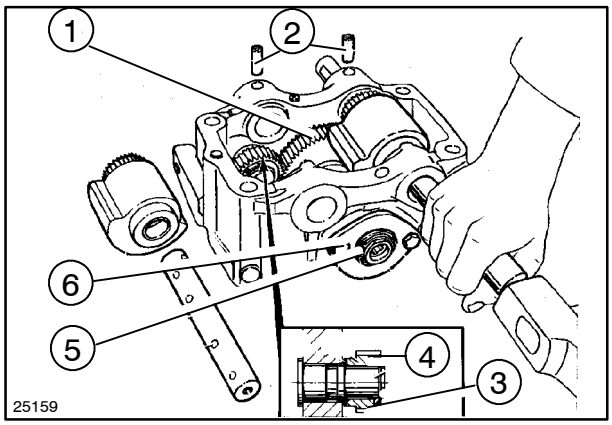
67. Unscrew the retaining bolts (4), remove the washers (3) and the engine lubrication oil pump (2), complete with the overpressure valve (1).



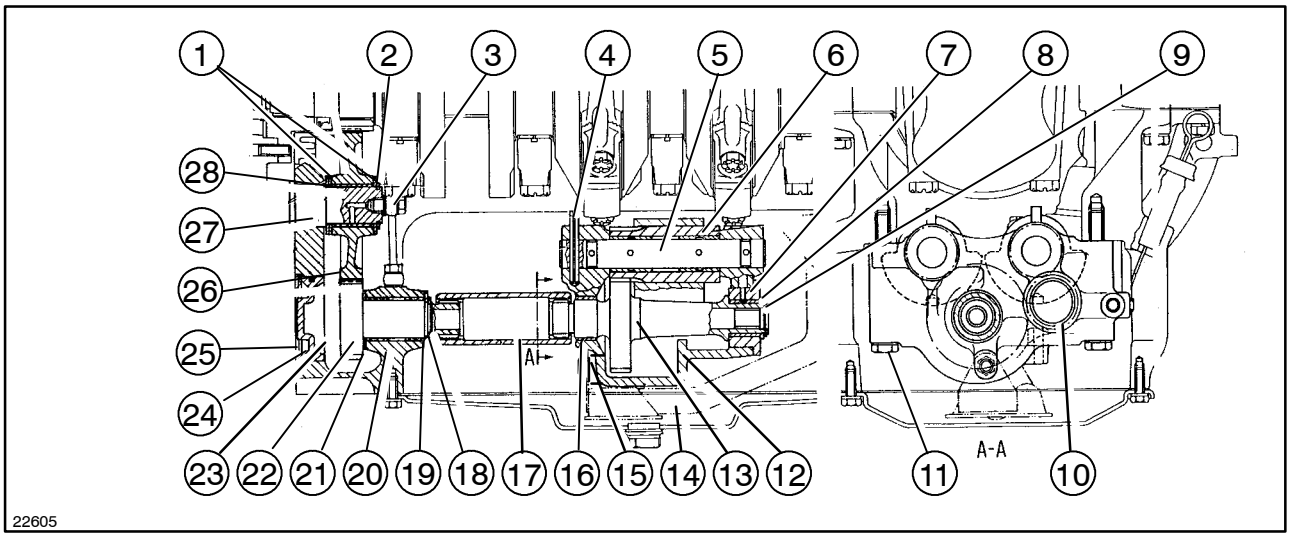
108

NOTE: *Operations 68. to 76. noted below, refer to the rotating counterweight equalizer disassembly.*

68. Remove the lubrication pipe (3) fig. 110.
69. Remove the circlip (18).
70. Remove the circlip (25), the cover (23) and O-ring seal (24).
71. Extract the gear unit from the sump (22).
72. Remove the circlip (2), the gear unit (26) and the washers (1).
73. Check that the shaft (27) shows no signs of wear or scoring. Replace if necessary.
74. Extract the pins (4) and disassemble the axes by striking with a punch.
75. Disassemble the gear unit (13) by re-moving the circlip (9) and the support retaining bolts (6, fig. 109).
76. Remove the circlip (4) and disassemble the intermediate gear unit (3).



109



110

Cross-sectional view of equalizer device.

1. Washers.
2. Retaining snap ring.
3. Bush lubrication pipe (28).
4. Axis retaining pin (5).
5. Rotating counterweight axis.
6. Counterweights.
7. Counterweight gear unit support (13).
8. Fifth wheel.
9. Retaining snap ring.
10. Counterweight intermediate gear unit.
11. Counterweight/sump retaining bolts.
12. Counterweight casing.
13. Counterweight gear unit.
14. Rose pipe.
15. Rose pipe retaining bolt.
16. Bush.
17. Rigid connecting sleeve.
18. Retaining snap ring.
19. Fifth wheel.
20. Gear unit support (22).
21. Fifth wheel.
22. Counterweight drive gear unit.
23. Seal cover.
24. O-Ring seal.
25. Retaining snap ring.
26. Idler gear.
27. Gear unit rotating axis (26).
28. Bush.

GENERAL NOTES

- After disassembling the engine, thoroughly clean the parts.
- Engine assembly operations should be carried out in reverse order to the disassembly operations described on pages 49 to 63.
- Pages 64 to 73 show the assembly operations that require extra attention in order to assemble parts correctly.
- The torque settings are shown on page 22.

ALSO REMEMBER THAT:

- When partially or fully disassembling the engine, all seals must be replaced.
- Before inserting rotating parts and seals in seats, lubricate the parts with engine oil.
- When fitting the oil filter, lubricate the seal with engine oil.

CAUTION

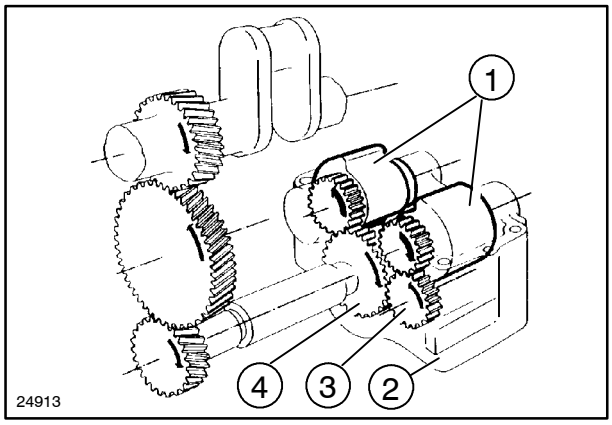
Handle all parts carefully, do not put your hands or fingers between parts and use appropriate tools to align fixing holes.

Wear suitable safety clothing - safety goggles, gloves and shoes.

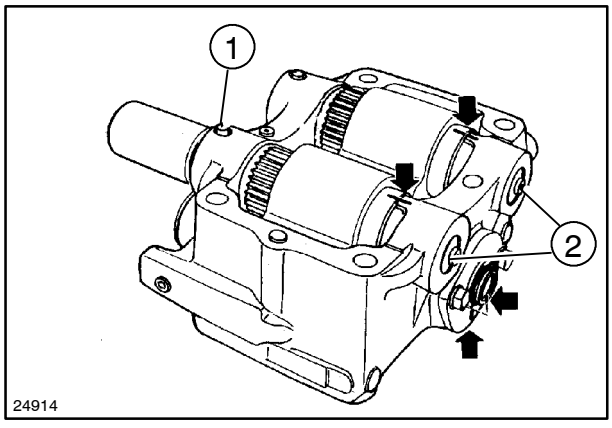
ROTATING COUNTERWEIGHT EQUALIZER ASSEMBLY (Disassembly operations 68. to 76.)

Proceed as follows:

- Carry out assembly operations on the counterweight casing (2) proceeding in reverse order to operations 74. to 76., position the gear unit (4) and the counterweights (1), so that the arrows are aligned (see fig. 112).
- the longest end of the hub on the counterweight intermediate gear unit (3, fig. 111) must be facing the casing wall;
- the holes for the pins (1, fig. 112) on the axes (2) must be aligned with the relative holes on the casing.
- Assemble the parts on the sump by following operations 68. to 72. in reverse order in relation to the description on page 63.



111



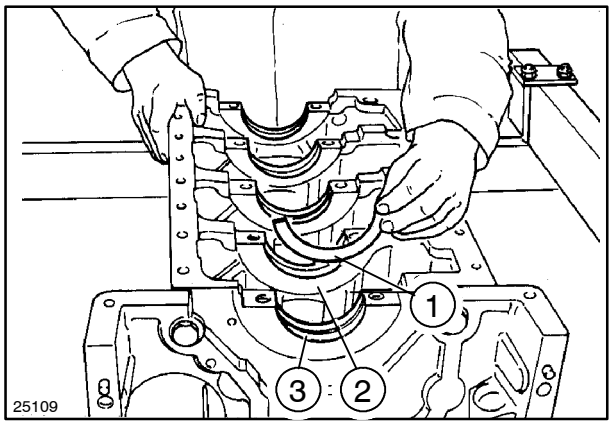
112

MOUNTING THE TAPPETS AND CRANKSHAFT WITH MAIN BEARING CAPS, BEARINGS AND THRUST RINGS, CHECKING AXIAL CLEARANCE OF CRANKSHAFT

(Disassembly operations 62. to 63.)

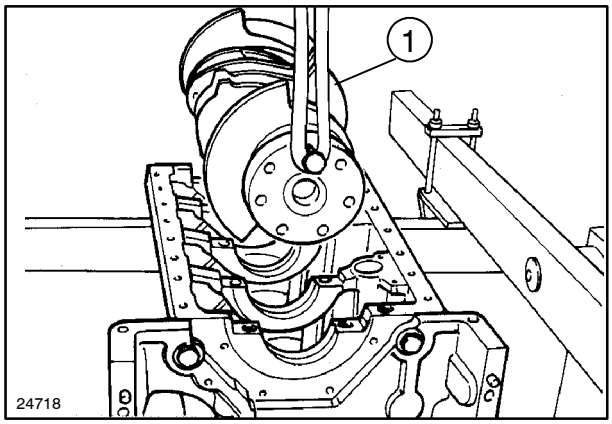
Proceed as follows:

- Install the tappets in their crankcase bores.
- Lubricate the main bearing seats with engine oil and install the half-shell bearings (3).
- Insert the two crankshaft semi-circular thrust washers (1) applying grease on the penultimate main bearing shims (2) to facilitate the operation.



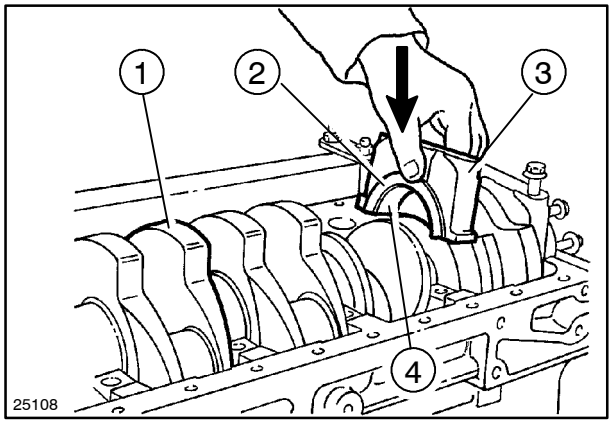
113

- Lubricate the upper surfaces of the main bearing shells with engine oil and lower the crankshaft (1) into position, taking care not to dislodge the semi-circular thrust washers installed previously.



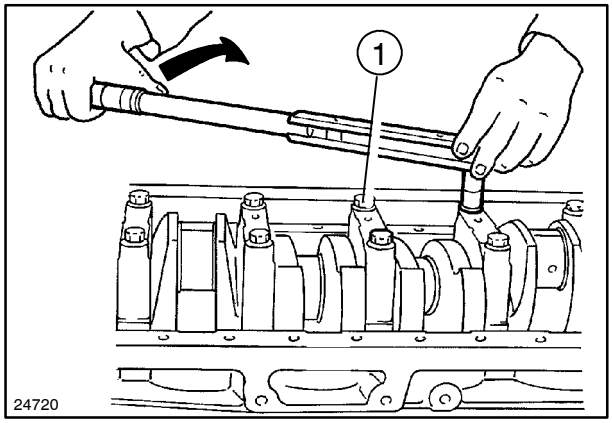
114

- Lubricate the crankshaft journals with engine oil and fit the main bearing caps (3) with the half-shells (4), fitting the top semi-circular thrust washers (2) to the penultimate bearing cap.
- Rotate the crankshaft (1) a few times to allow the parts to settle into position.
- Insert the main bearing cap bolts and screw in until the head of the bolt is up against the cap.



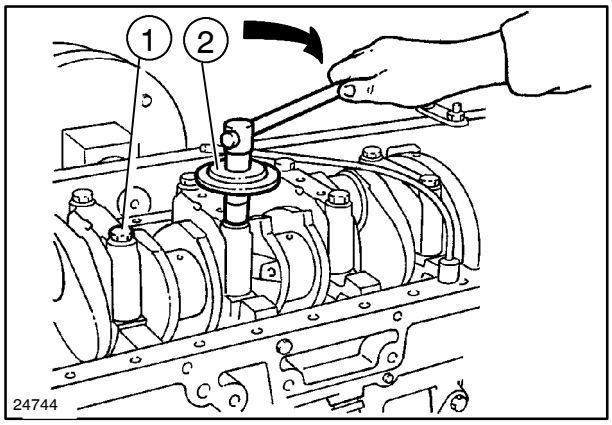
115

- Tighten all cap bolts (1) to a torque of 80 Nm (8.2 kgm).



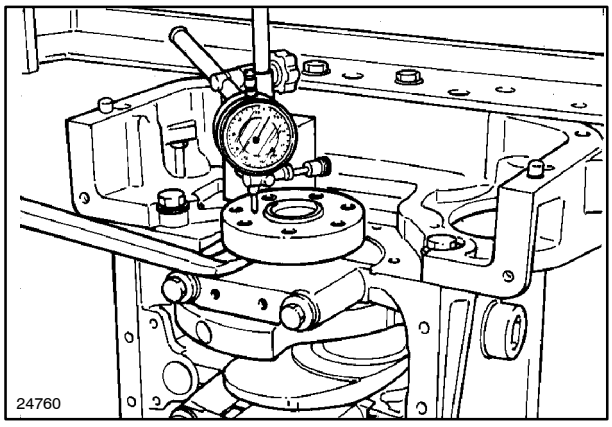
116

- Using tool **380000304** (2) tighten each bolt (1) through a further 90°.



117

- Check that the crankshaft endfloat does not exceed the value specified on page 15.



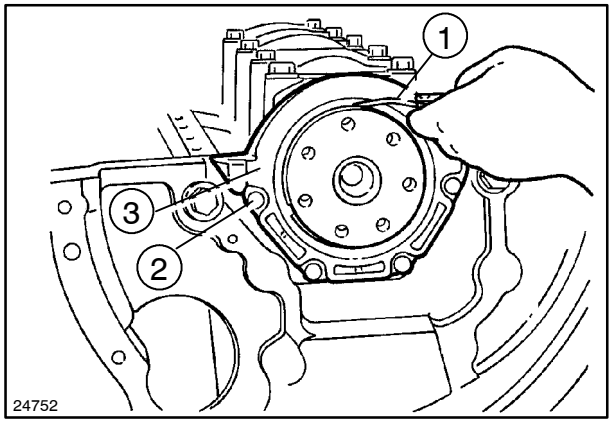
118

MOUNTING THE REAR COVER WITH SEAL AND ENGINE FLYWHEEL

(Disassembly operation 61.)

Proceed as follows:

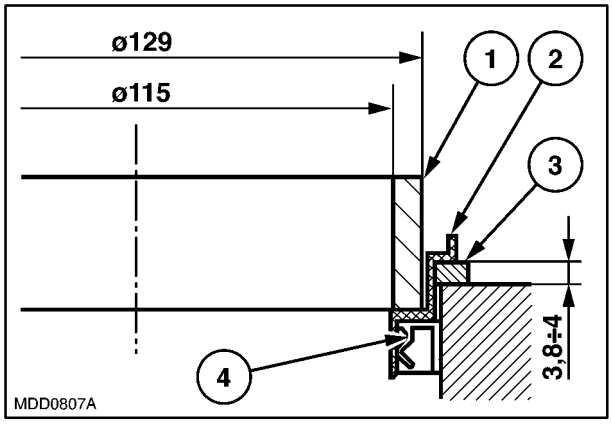
- Fit the rear oil seal carrier (3) with the outer seal. Tighten the retaining bolts (2) to the torque specified on page 22. Using a feeler gauge (1), check that the crankshaft flange is coaxial with the carrier.



119

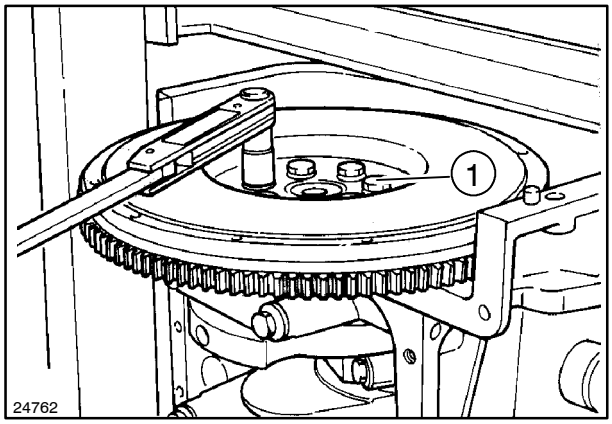
To fit the internal seal on the rear cover (3, fig. 119), proceed as follows:

- Using a seal chock (2), insert the spacer (3, fig. 2, part of tool **50139**) and the rear internal seal (4).
- Using tool (1, fig. 2, part of tool **50139**), insert the seal (4).
- Extract the tool (1), chock (2) and spacer (3), leaving the seal in position (4).



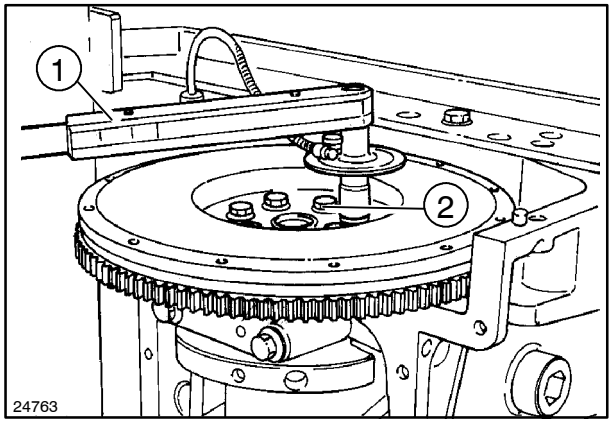
120

- Fit the flywheel and tighten the retaining bolts (1) to a torque of 40 Nm (4.1 kgm).



121

- Using tool **380000304** (1), tighten each flywheel bolt (2) through a further 60°.



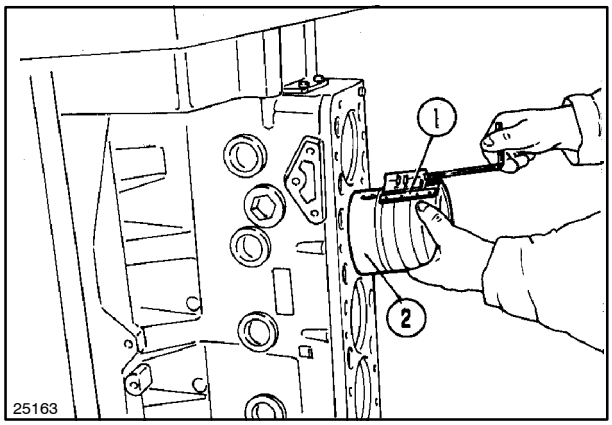
122

MOUNTING THE PISTONS COMPLETE WITH RINGS, PINS, CONNECTING RODS, BIG END CAPS AND BEARINGS - CHECKING PROTRUSION IN RELATION TO CYLINDER BLOCK FACE

(Disassembly operations 58. and 59.)

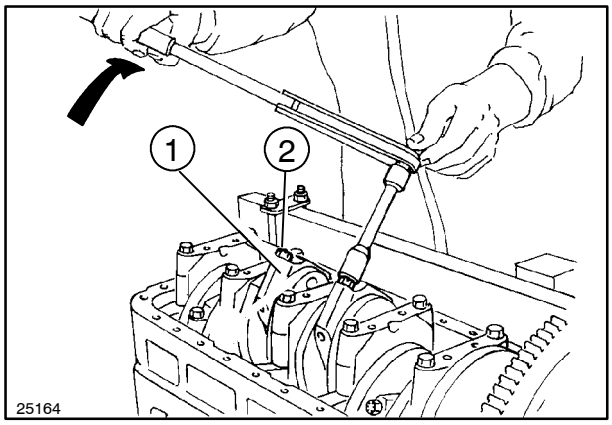
Proceed as follows:

- Lubricate pistons, rings and cylinder liners with engine oil prior to fitting.
- Using piston ring pliers **380000221** fit the piston rings. Make sure that the piston ring gaps are offset at 180°.



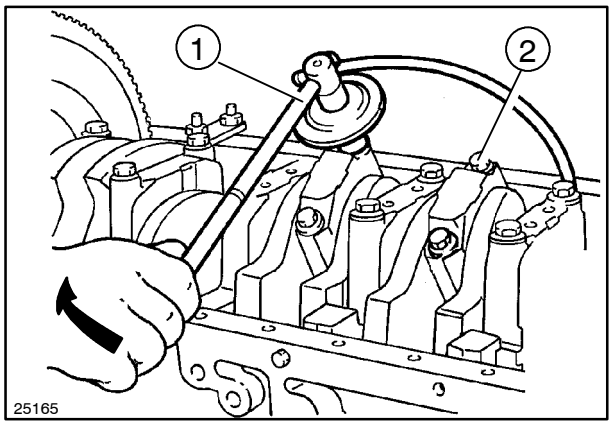
123

- Fit tool **380000220** (1, fig. 123) to insert the pistons (2) in the cylinder sleeves, taking care not to offset the gaps in the rings (described in the previous point.
- Insert the piston / connecting rod into the cylinder liner, checking that the connecting rod number corresponds with the cylinder number and that the number stamped on the connecting rod is facing away from the camshaft.
- Fit the big-end caps (1) with their bearings onto the crankshaft and tighten the retaining bolts (2) to a torque of 40 Nm (4.1 kgm).



124

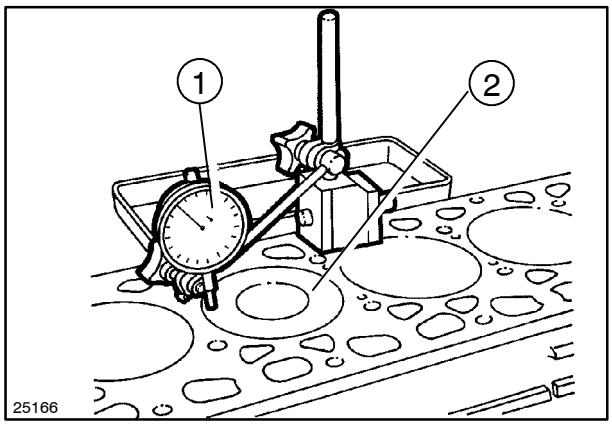
- Using tool **380000304** (1), tighten each big-end cap bolt (2) through a further 60°.



125

- Turn the rotating stand through 180° and clean the upper surface of the crankcase.

  Bring the pistons (2), up to TDC and, using a dial gauge with a magnetic base (1) check that the piston protrusion (2) from the cylinder block face is within the tolerance limits specified on page 17.



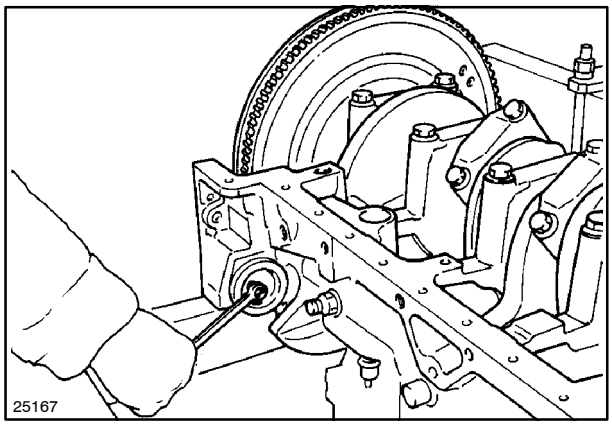
126

SYNCHRONISING THE TIMING GEARS

(Disassembly operations 50. to 54.)

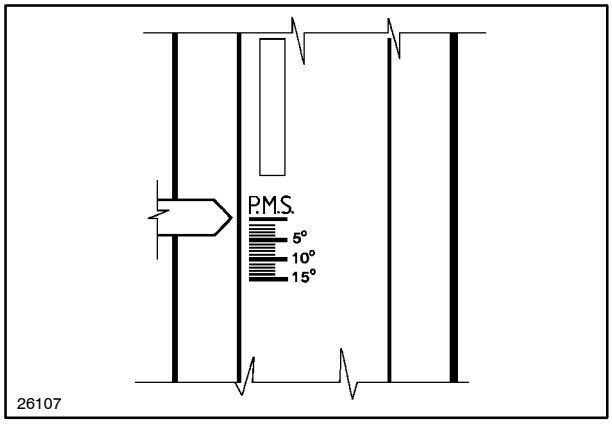
Proceed as follows:

- Remove the cover of the flywheel housing inspection window and its gasket.



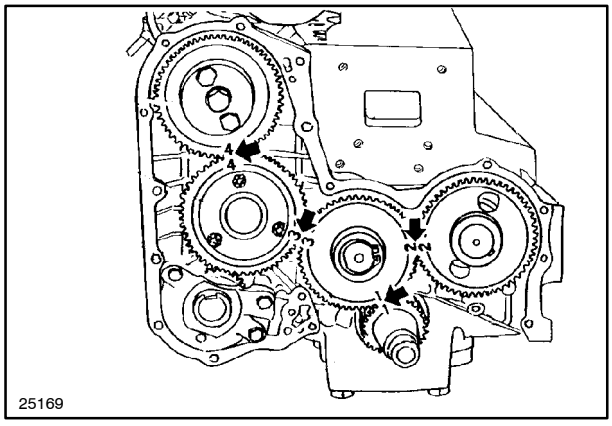
127

- Rotate the crankshaft to bring cylinder no. 1 to TDC (compression stroke).
  Look through the inspection window to check that the notch in degrees aligns with the index mark, according to the type of BOSCH pump installed on the tractor (see pages 6-8-10-12).



128

- Fit the timing gears, making sure that the various reference marks on the gears are aligned.



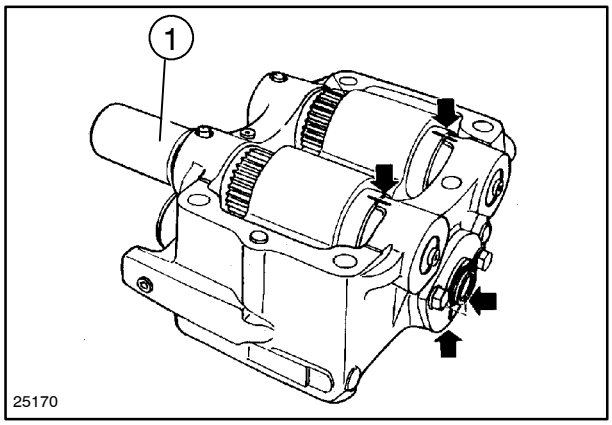
129

INSTALLING THE ROTATING COUNTERWEIGHT CASING ON THE OIL SUMP

(Disassembly operation 40.)

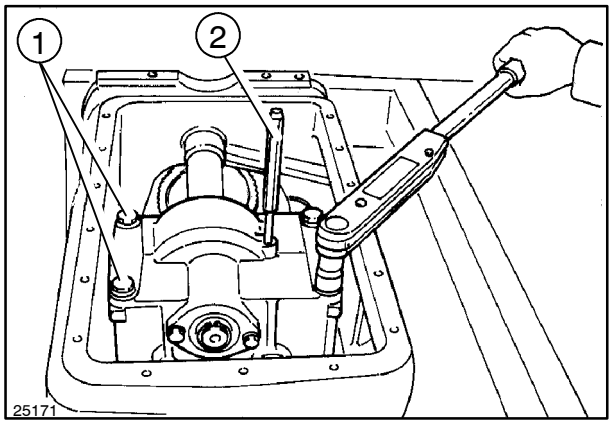
When refitting the rotating counterweight casing, timing operations must be carried out as follows:

- Move piston no. 1 to TDC.
- Time the rotating counterweight casing by aligning the marks shown in the figure.



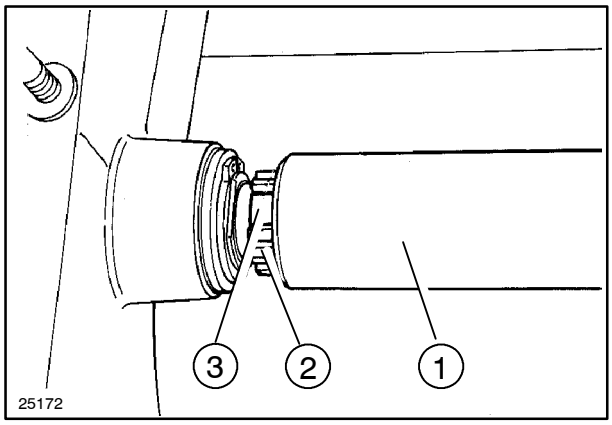
130

- Overturn the rotating counterweight casing, insert the pin (2) in the hole in order to maintain timing on the unit during assembly operations.
- Position the rotating counterweight casing, using a hoist and chains, inside the sump, resting it on the plate.



131

- Insert the sleeve (1) on the counterweight gear unit groove, as shown in figure 130.
- Insert the sleeve (1) on the counterweight drive gear unit shaft (2), aligning the upper parts with the oversized timing spaces (3).
- Tighten the retaining bolts (1) fig. 131 of the rotating counterweight casing to the torque specified on page 22.

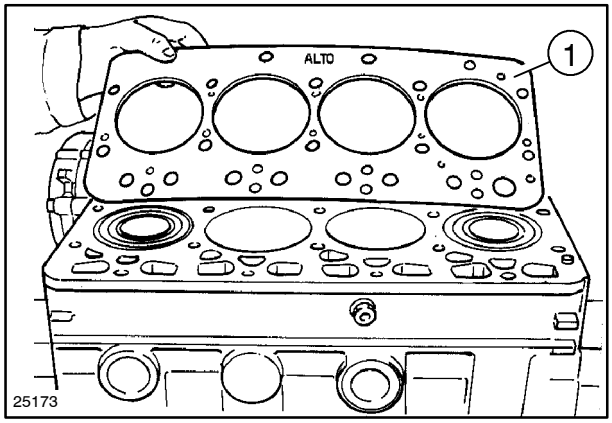


132

FITTING THE CYLINDER HEAD GASKET
(Disassembly operation 37.)

Proceed as follows:

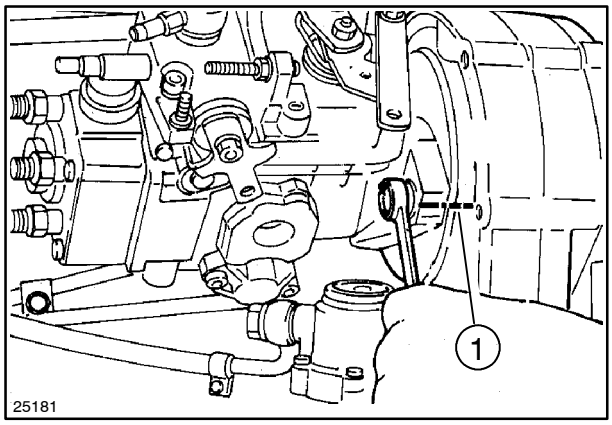
- Before fitting the cylinder head, carefully clean and degrease the mating surface of the cylinder block. Locate the cylinder head gasket (1) with the word **UP** uppermost.



133

REFITTING THE BOSCH INJECTION PUMP
(Disassembly operations 22. to 25.)

- Fit the BOSCH injection pump and proceed with the injection pump timing, as described on pages NO TAG to 112.



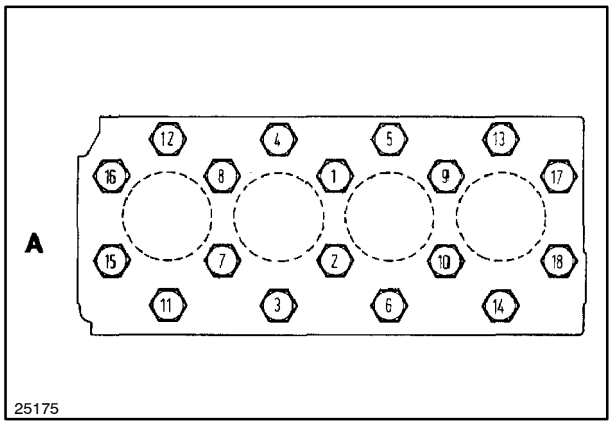
134

FITTING AND TIGHTENING THE CYLINDER HEAD (Disassembly operation 36.)

Proceed as follows:

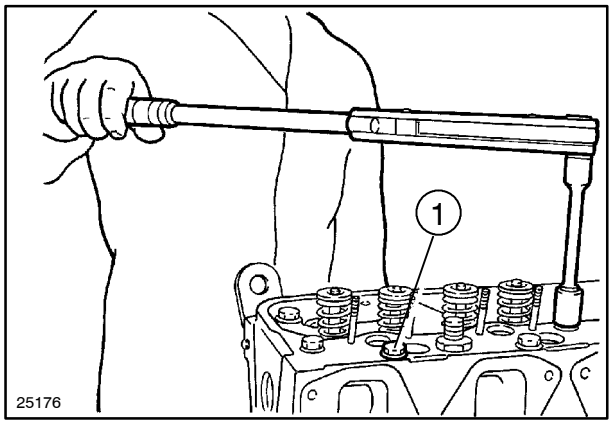
- Lower the cylinder head onto the block and screw in the cylinder head bolts (1, fig. 136) to make contact with the head.

- Tightening sequence for 4-cylinder head bolts (1, fig. 136) to be followed for each of the four tightening stages.
  (Fan side).



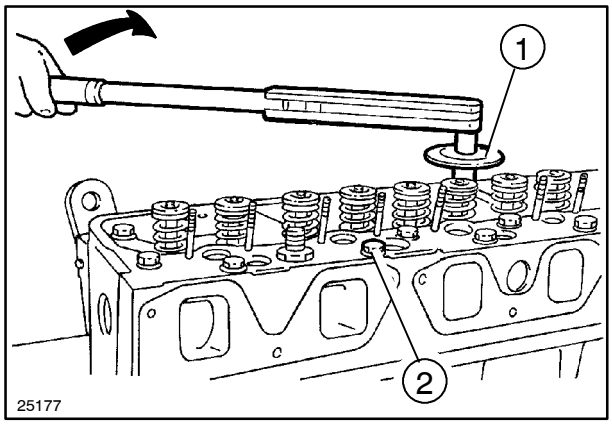
135

- **(1st phase)**
  Tighten the bolts (1) to a torque of 70 Nm (7.1 kgm) in the sequence shown in the figure 135.
- **(2nd phase)**
  Check the torque of all the bolts (1) in the sequence indicated in the figure 135.



136

- **(3rd phase)**
  Using tool **292248** (1) tighten each cylinder head bolt (2) through 90°, following the sequence indicated in the figure 135.
- **(4th phase)**
  Tighten through a further 90° for each bolt (2) following the sequence indicated in the figure 135.



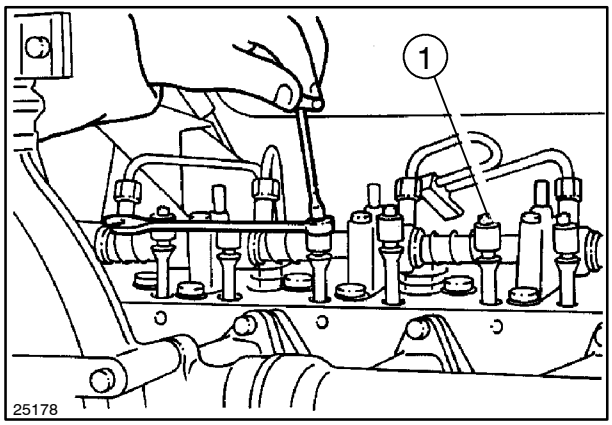
137

ADJUSTING VALVE / ROCKER ARM CLEARANCE

(Disassembly operation 33)

- Before refitting the rocker cover, adjust the valve clearances as described on pages 100 and 101.

- Tighten the rocker arm adjuster screw locknuts (1) to the torque specified on page 22.



138

FITTING INJECTORS
(Disassembly operation 32)

- Proceed as follows:

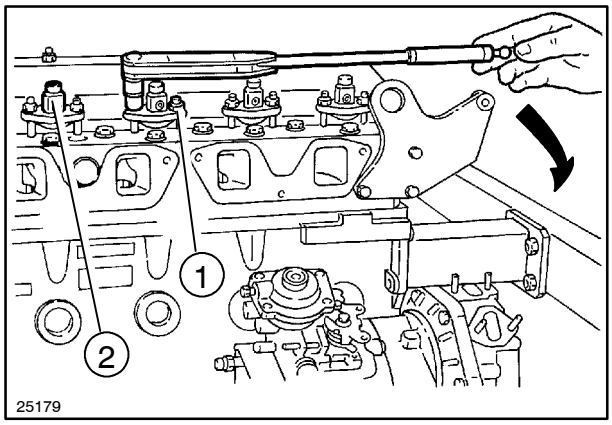
- Insert the injectors (2) in their respective bores.

- Position the injector support brackets and fit the spherical washers.

- Screw the bracket retaining nuts (1) up to the spherical washers then, using a torque wrench, tighten to the torque specified on page 22 in two stages:
  1st stage, tighten nuts to 10 Nm (1 kgm):
  2nd stage, tighten nuts to 25 Nm (2.6 kgm).

- Tighten the injector leak-off pipe unions.

- Tighten the high-pressure fuel line unions.



139

ADJUSTING BELT TENSION ON THE COOLING SYSTEM
(Disassembly operations 3 to 6)

NOTE: *Tension the belt correctly as indicated in operation* ***10 414 10****.*

CHECKS, DIMENSIONS AND REPAIRS (CYLINDER BLOCK, LINERS)

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

Clean all parts carefully before proceeding with the operations described below.

NOTE: *Cylinder liner dimensions must only be measured when the liner is installed in the cylinder bore, as they are subject to deformation when not fitted.*

Check liner wear as follows:

- measure the inside diameter in the area swept by the piston rings (X, fig. 142);
- measure the inside diameter at the upper and lower ends of this area both parallel to the crankshaft centre line (a) and perpendicular to the crankshaft centre line (b);
- compare these measurements to determine liner ovality and taper.

To check piston running clearance, measure the I.D. of each liner in the area (Z, fig. 142) only along the axis (b) perpendicular to the crankshaft centre line.

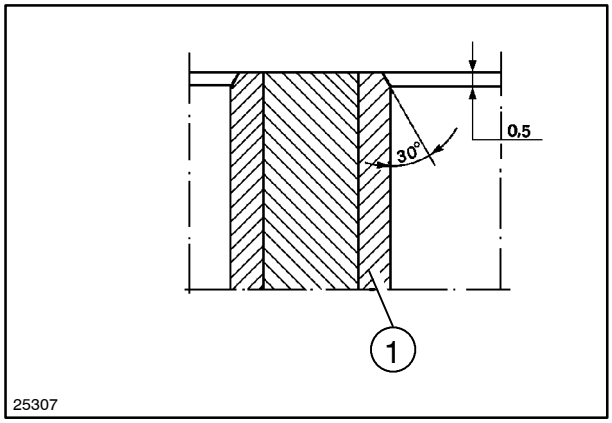
If the bore is out of round or tapered by more than 0.12 mm or the piston clearance exceeds 0.01 in. (0.3 mm), it is necessary to re-bore and re-grind (or perhaps replace) the liners, taking them to one of the sizes specified in the chart on page 14.

Then pair up the cylinder liners with the pistons of the same dimensions (see page 17).

NOTE: *If one of the liners is rebored, all of the liners in the engine must also be rebored to the same oversize.*

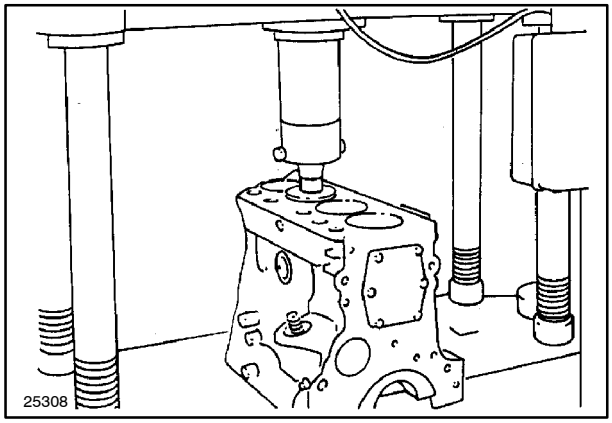
After re-grinding, it is necessary to restore the chamfer on the liner (1) to 0.2 in. (0.5 mm) at 30°.

In case of replacement, remove and install the liners in the cylinder block cold using a press as follows:

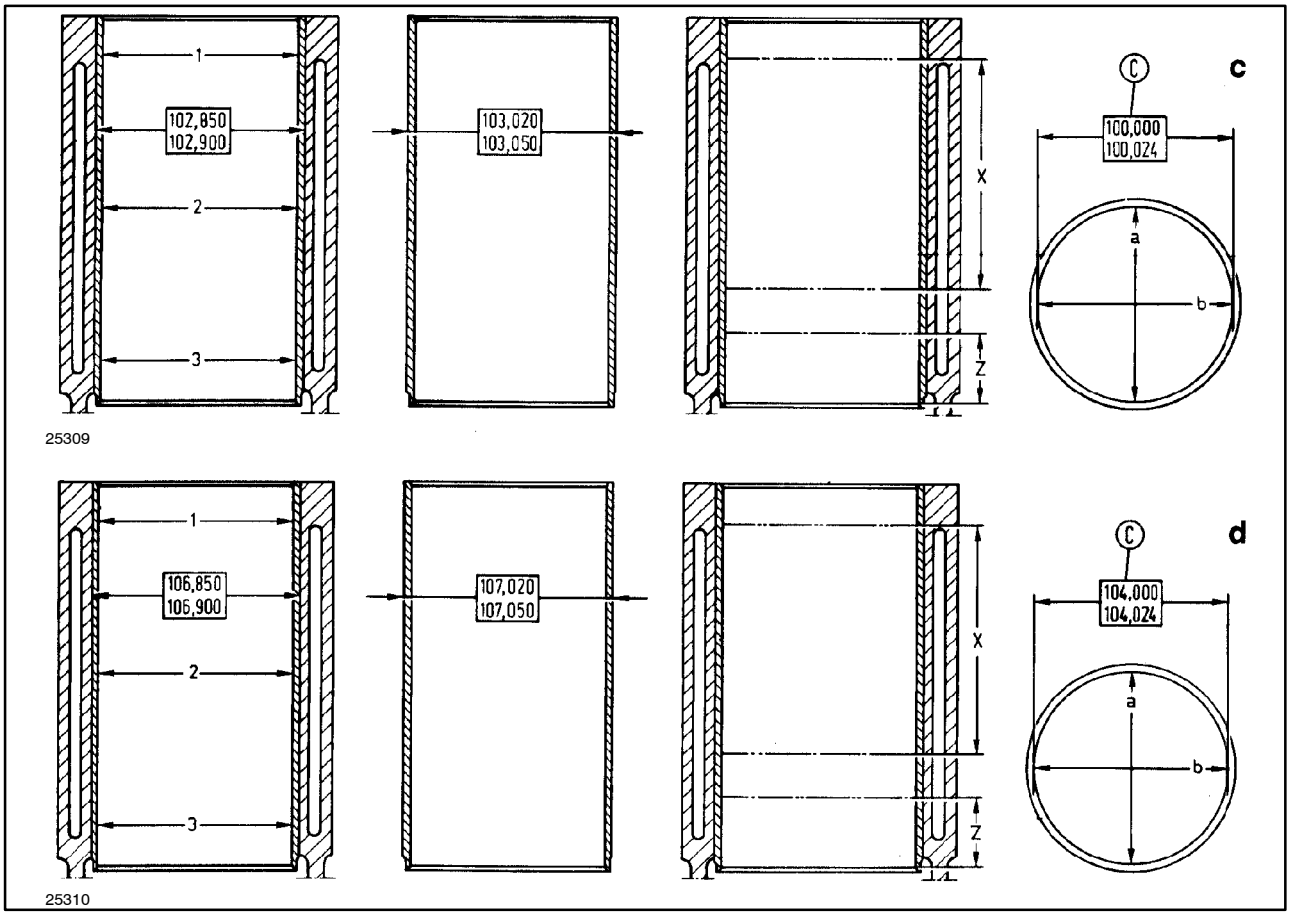


140

- Press the worn liner out of the block operating from the bottom of the crankcase using the appropriate plates.
- Check the ovality of the bore in the block and rebore if necessary to 0.007 in. (0.2 mm) oversize.
- Press-fit the new liner 0.007 in. (0.2 mm oversize if necessary) from the top of the block, using the appropriate plate.
- Rebore and ream the liner to the specified I.D. (see page 14).



141



142

Standard dimensions (mm) of cylinder liners and bores in the cylinder block and positions for checking liner wear.

a,b Perpendicular positions of dial gauge to measure liner I.D.

c Model TL70.

d. Models TL80, TL90, TL100.

C. Dimension to obtain after press-fitting and reaming of liner.

Z. Area for measurement of inside diameter of used liners to determine piston running clearance (measured along axis b perpendicular to crankshaft).

X. Area for measurement of inside diameter of worn liners (area swept by piston rings) to determine ovality and taper (measure along axes a and b, respectively parallel and perpendicular to the crankshaft).

1,2,3. Planes of measurement of the internal diameter of new and ground liners, along the two perpendicular axes (a, b).

CHECKS, DIMENSIONS AND REPAIRS - CRANKSHAFT, MAIN BEARINGS AND FLY-WHEEL

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

Crankshaft

Clean all parts carefully before proceeding with the operations described below.

Carefully examine the crankshaft. If even slight cracks are found, replace the crankshaft.

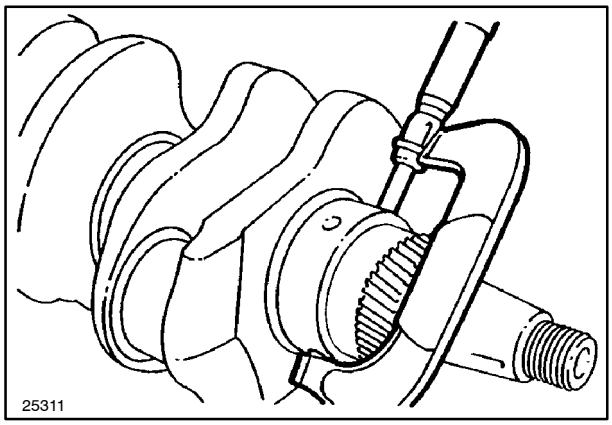
Inspect the crankshaft journals and crankpins; slight scoring or seizure marks can be removed with very fine grade emery cloth.

If scoring, ovality or taper exceeds 0.001 in. (0.05 mm), the journals will have to be reground.

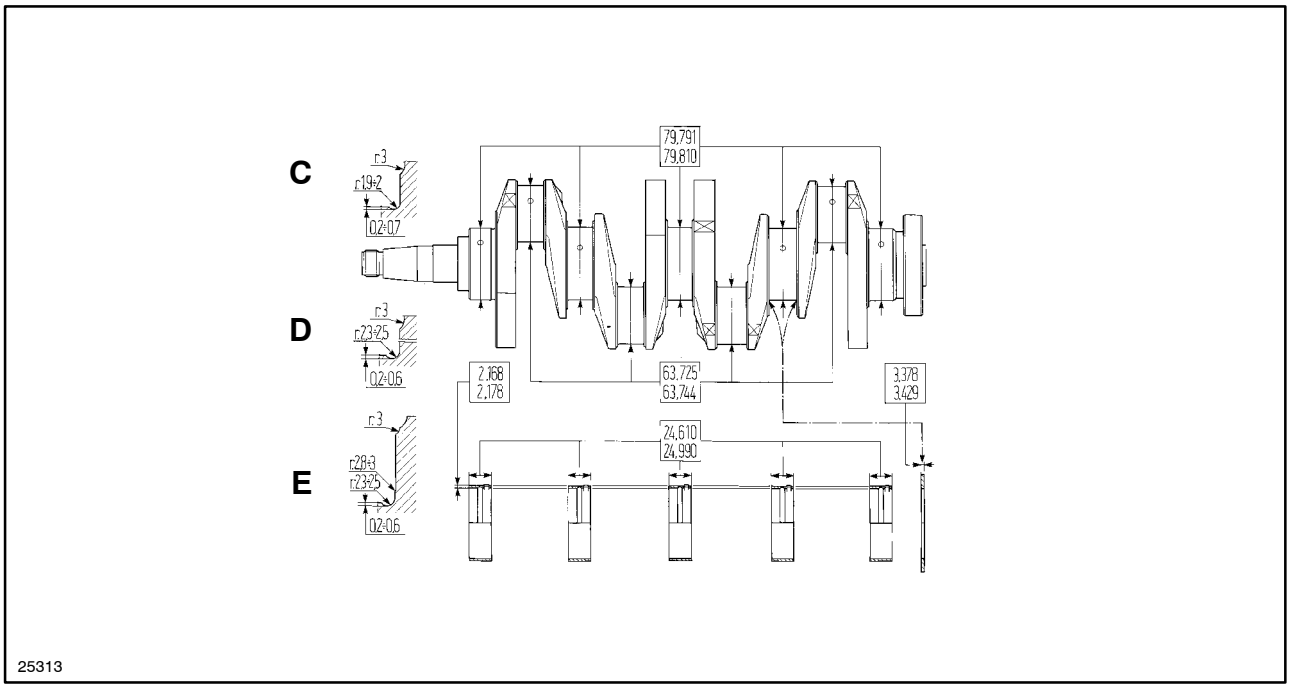
Measure journal diameter to determine the nearest undersize (see page 15).

After regrinding, restore the journal and crankpin rounds and fillets as shown in fig. 144 and check that:

- main bearing journal and crankpin ovality does not exceed 0.0003 in. (0.008 mm);
- main bearing journal and crankpin taper does not exceed 0.0003 in. (0.01 mm);



143



144

Standard dimensions (mm) of main bearing journals and crankpins, main bearings and semi-circular thrust washers.

C. Crankpin rounds and fillets.

D. Normal crankshaft journal rounds and fillets.

E. Rounds and fillets of crankshaft journal with thrust washers.

- with the crankshaft resting on parallel gauge blocks, the maximum misalignment of the main bearing journals does not exceed 0.004 in. (0.10 mm) (D) fig. 145;

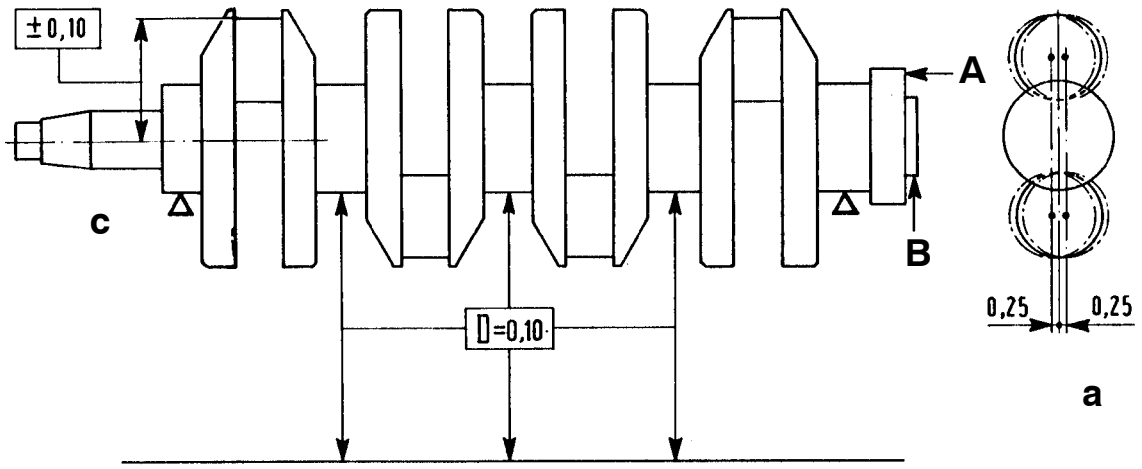
- the centrelines of each pair of crankpins lie in the same plane as the main journal centrelines, with a maximum deviation of ± 0.01 in. (± 0.25 mm) as measured perpendicularly to the same plane);

- the distances between the outer surfaces of the crankpins and the crankshaft centreline are equal to a tolerance of ± 0.004 in. (± 0.10 mm);

- the run-out measured with the dial gauge contact point resting on surface (A) or (B) does not exceed the value specified in the table on page 16;

- the oil plugs seal against an oil pressure of 213.2 psi (14.7 bar);

- if new plugs are fitted, punch-lock in position and re-check oil tightness with the system pressurised.



145

Maximum tolerances for alignment of main bearing journals and crankpins relative to crankshaft centreline and alignment of crankpins relative to main bearing journals (a).

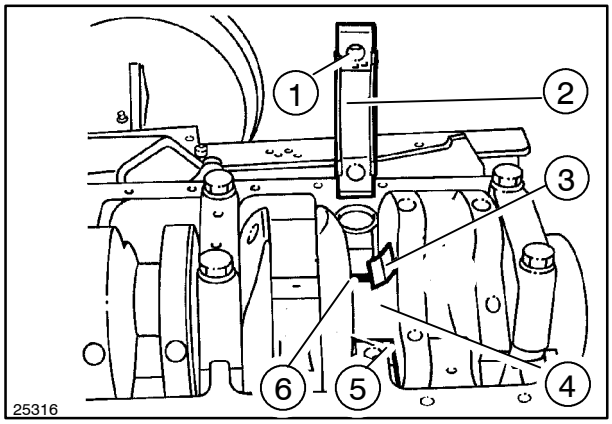
A. and B. Dial gauge contact point positions for checking perpendicular run-out of flywheel mounting flange.

D. Maximum permissible main bearing journal alignment deviation.

Bearings

Check the clearance between the crankshaft journals and the bearing shells using a calibrated wire gauge as follows:

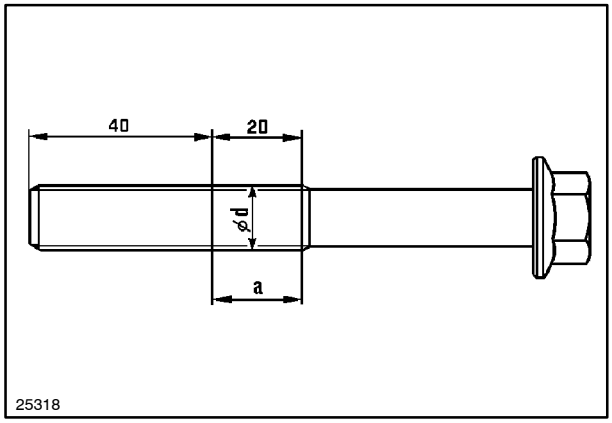
- make sure that all parts are perfectly clean and remove all traces of oil;
- locate the half-shells in their respective seats (5);
- install the crankshaft;
- position a length of calibrated wire (6) on the crankshaft journals (4) parallel to the crankshaft centreline;
- fit the caps (1), complete with half-shells (2), on their supports;
- lubricate the bolts (4, fig. 3) on the caps with engine oil and tighten with a torque wrench to the prescribed value (see page 22);



146

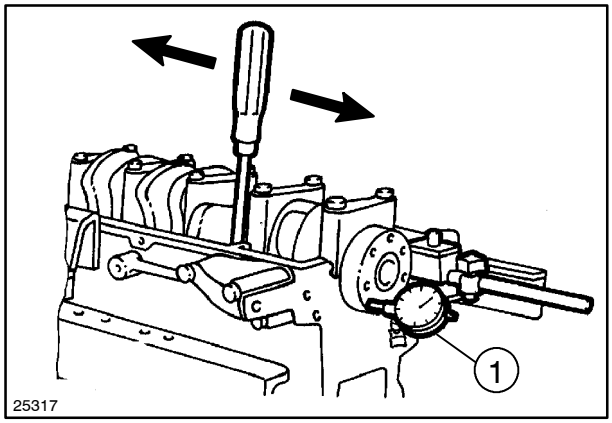
Main bearing cap bolts (4, fig. 3)

If reusing the bolts, check that the diameter **d** (measured as shown in the figure alongside, zone a) is greater than 0.53 in. (13.5 mm); change the bolts if it is not.



147

- remove the caps and determine the bearing clearance by comparing the width of the calibrated wire at the widest point against the scale printed on the packet (3, fig. 146) containing the wire;
- after refitting the crankshaft and the bearing caps and bolts, check crankshaft endfloat, using a dial gauge (1), at the penultimate cap;
- if the endfloat exceeds the specified value (see page 15), replace the existing thrust washers with oversize washers.



148

Flywheel

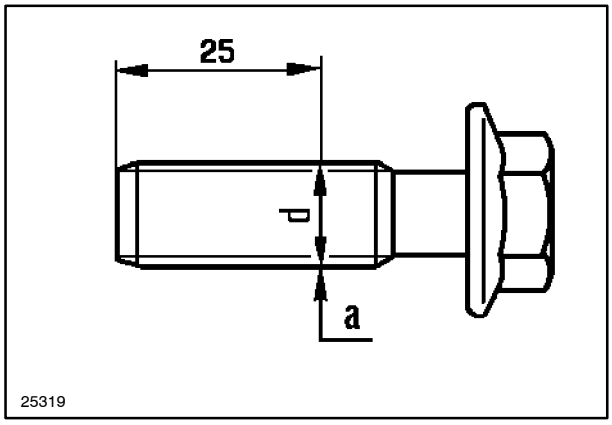
The flywheel is fixed to the crankshaft flange by means of self-locking bolts. The starter ring gear is force-fitted after pre-heating to the register on the engine side of the flywheel.

If the ring gear is to be replaced, heat in oil to 176° to 194°F (80° to 90 °C) before fitting, and position with the bevel on the teeth facing inward (starter motor side).

The flywheel mounting holes are offset so that the flywheel can only be mounted in one position.

NOTE: *To rebore the flywheel, see Section 18.*

- lubricate the flywheel retaining bolts (3, fig. 3) with engine oil, and tighten them to the prescribed torque using a torque wrench (see page 22);



149

Flywheel retaining bolts (3, fig. 3)

If reusing the bolts, check that the diameter **d** (measured as shown in the figure alongside, zone a) is greater than 0.45 in. (11.5 mm); change the bolts if it is not.

CHECKS, DIMENSIONS AND REPAIRS - CONNECTING RODS

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

Clean all parts carefully before proceeding with the operations described below.

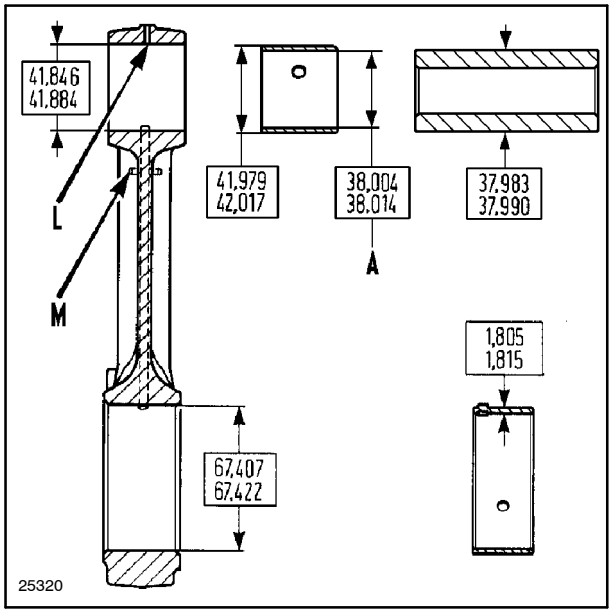
Check that the bushings in the connecting rod small ends are tight in their bores and are flush with the sides of the rods.

If necessary, replace the bushings and ream after fitting to the specified diameter (A) shown in the figure 150.

Dimensions (mm) of standard connecting rods, bearing shells, bushings and gudgeon pins

A. Dimensions to obtain by reaming after fitting bushings.

L, M. Oil ports.



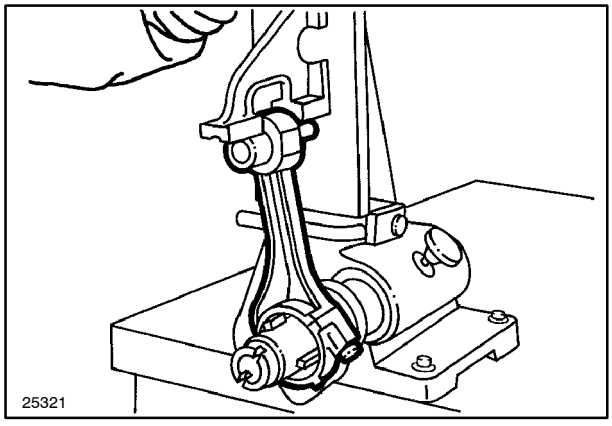
150

Check parallelism of small end and big end axes. Maximum permitted tolerance is ± 0.003 in. (± 0.07 mm) measured at 4.9 in. (125 mm) from the longitudinal axis of the connecting rod.

Slightly twisted con rods can be straightened using a press. Severely deformed rods should be replaced.

New con rods must be marked with the number of the cylinder in which they are to be fitted. Check that the difference in weight of the connecting rods in the same engine does not exceed 0.003 lbs. (25 g).

Also check that the oil ways (L and M, fig. 150) are not obstructed by scale or impurities.



151

CHECKS, DIMENSIONS AND REPAIRS - PISTONS

⚠ CAUTION ⚠

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

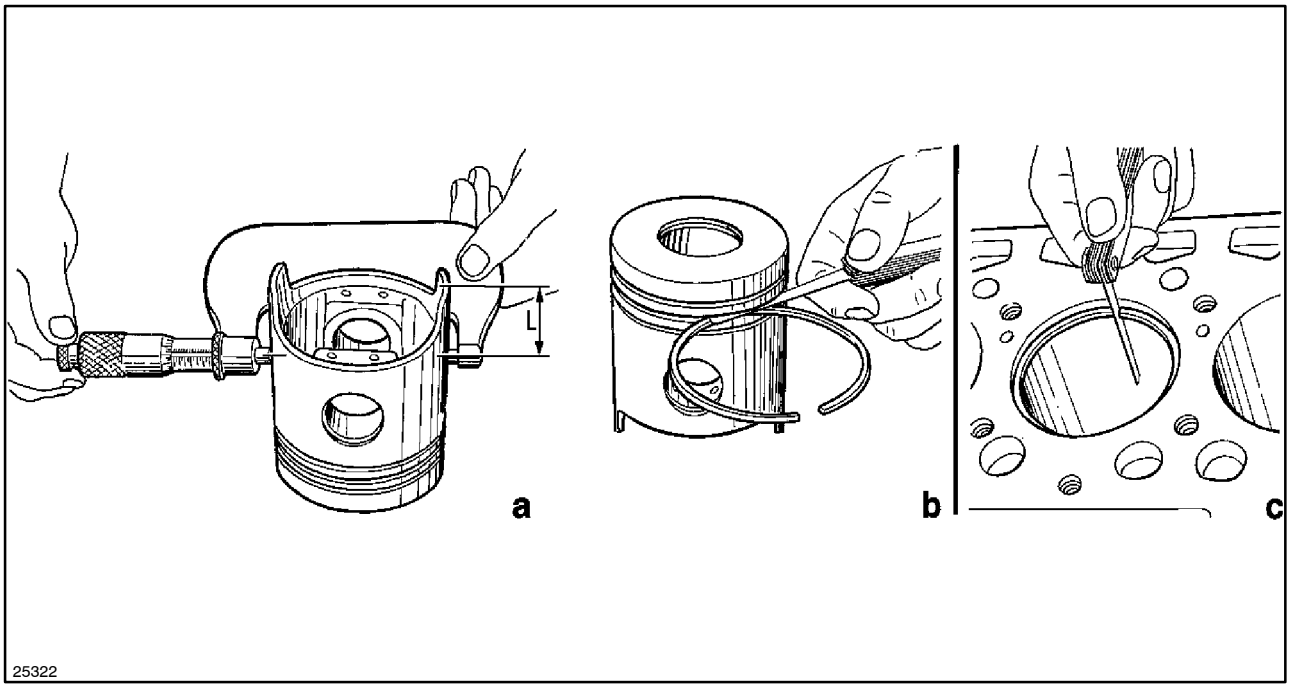
Clean all parts carefully before proceeding with the operations described below.

Determine the degree of piston and liner wear in the manner described on pages 14 and 17 and in the figures below.

If the piston running clearance exceeds 0.01 in. (0.30 mm), rebore and ream the liners and fit oversize pistons and rings (see pages 14 and 17).

In the event of piston replacement, check that the difference in weight between pistons in the same engine does not exceed 0.003 lbs (20 g).

Check that the clearance of the rings in the piston liners (b) fig. 152 and the gap between the ends (c) is the same as the values shown on page 17. If the end gap is less than that specified, correct by grinding the ends of the piston ring.



152

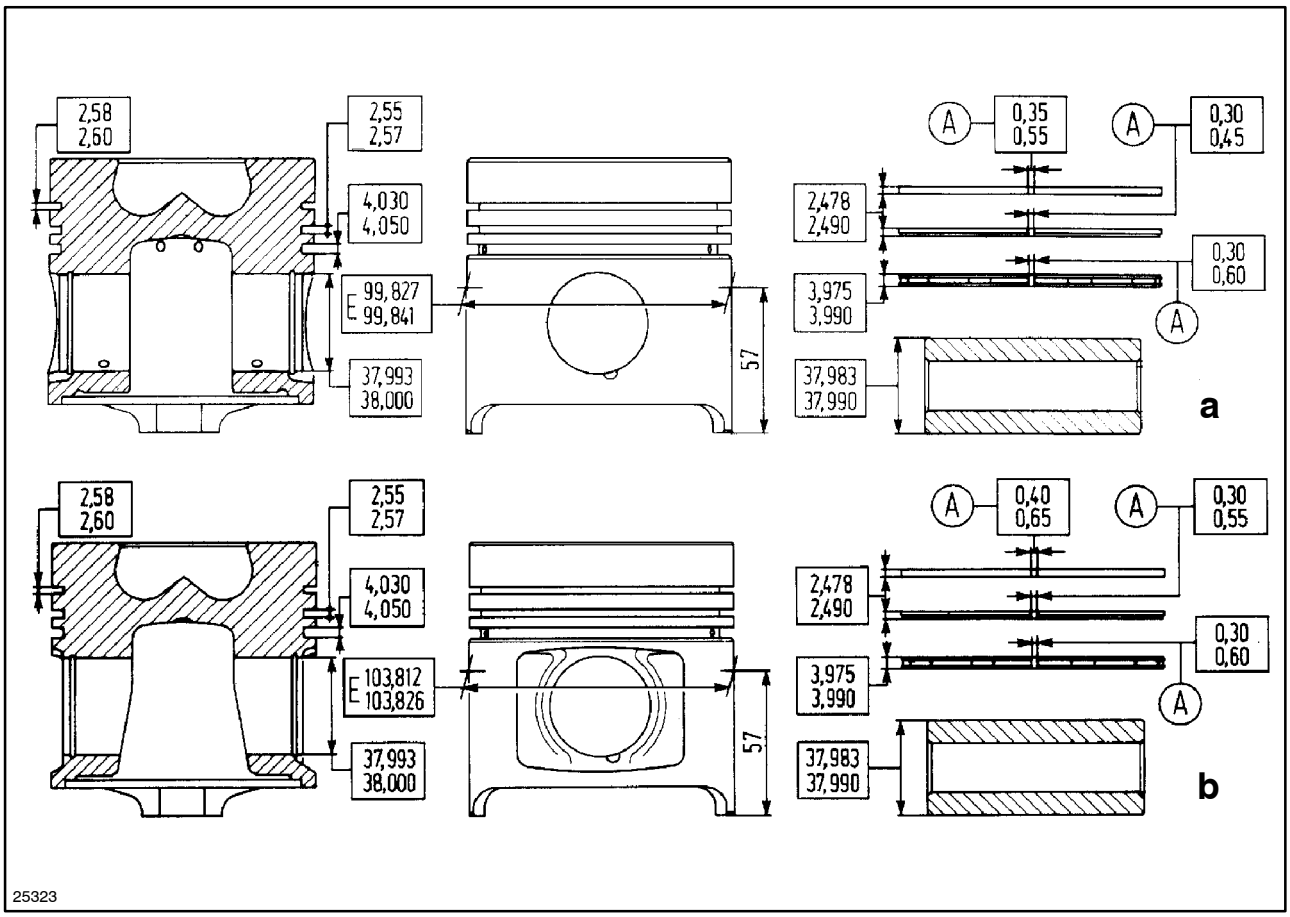
Checking pistons and rings.

a. Checking piston diameter at a distance (L) from the base of the skirt.

b. Checking piston ring groove clearance.

c. Checking the end gap with ring in cylinder bore.

L. Distance from the base of the piston skirt: 2.24 in. (57 mm).



153

Dimensions (mm) of standard pistons, gudgeon pins and rings.

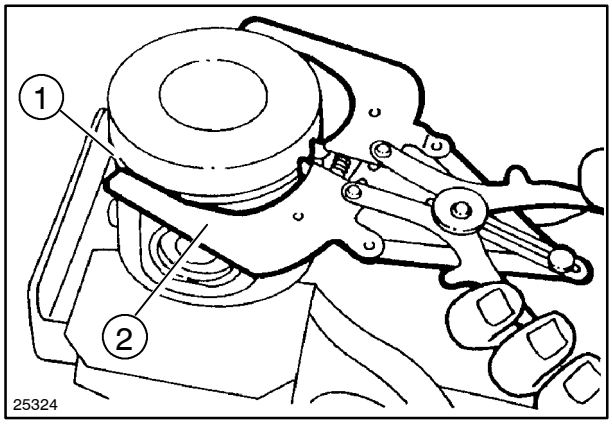
a. Model TL70.

b. Models TL80, TL90, TL100.

A. Measurement to be obtained with rings inserted in cylinder liners.

E. Piston diameter measured at 2.24 in. (57 mm) from the base of the skirt.

To remove or fit piston rings (1) use pliers **380000221** (2).



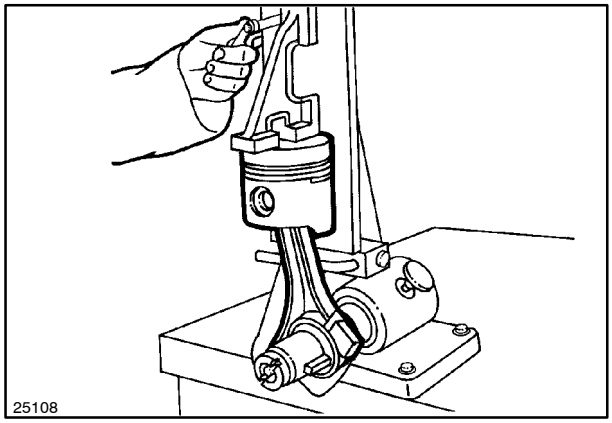
154

Fit rings in grooves in the order indicated in fig. 153.

When fitting pistons on connecting rods, check that the clearance between the gudgeon pin and its bore in the piston is within the tolerance specified on page 17.

Check that the piston/connecting rod assembly is perfectly square.

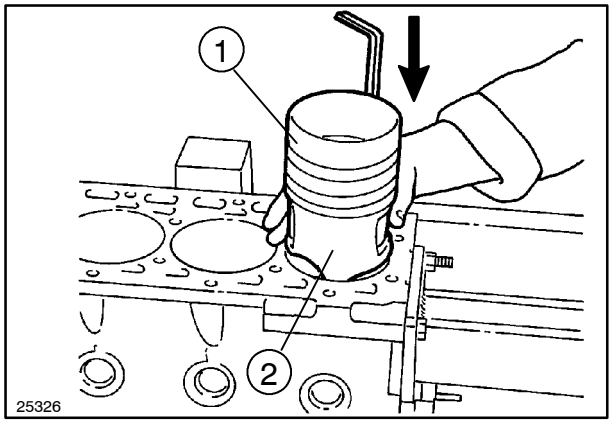
If not, replace parts causing the problem.



155

NOTE: *Oil the pistons, rings and liners before inserting the pistons in their bores.*

Remember that, before fitting the ring clamp ***380000220*** *(1) to insert the pistons (2) in the cylinder liners, it is necessary to check that the ring end gaps are offset to each other by an angle of 180°.*

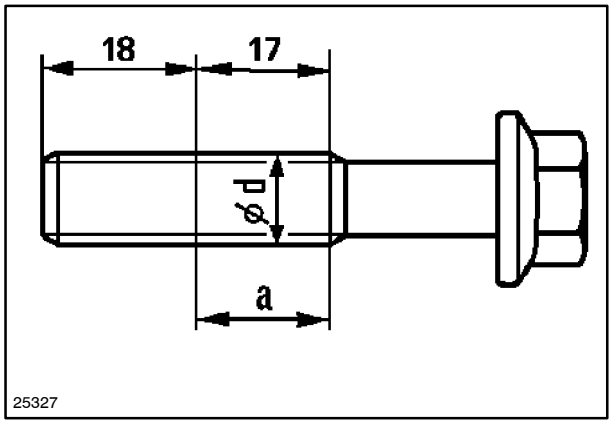


156

Big end cap bolts (5, fig. 3)

If reusing the bolts, check that the diameter **d** (measured as shown in the figure alongside, zone a) is greater than 0.41 in. (10.5 mm); change the bolts if it is not.

NOTE: *It is advisable to replace the big end cap bolts each time the connecting rods are dismantled.*



157

CHECKS, DIMENSIONS AND REPAIRS - CAMSHAFT, TAPPETS AND VALVES

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

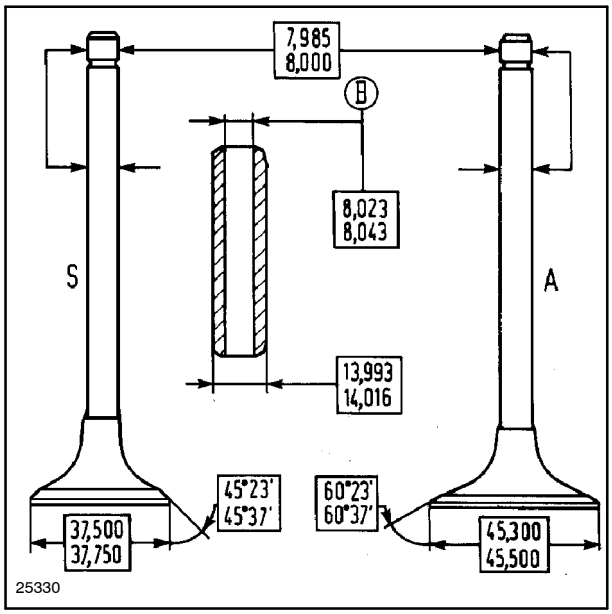
Clean all parts carefully before proceeding with the operations described below.

Valves

Use tool **380000302** for valve removal and installation.

In the case of minor sealing faults, the valves and their seats in the cylinder head may be re-faced using a pneumatic grinder or universal grinder. In the event of more serious defects, re-face the seats and grind the valves as shown in the relative chapter.

After grinding, check that the step below the valve contact band is no less than 0.02 in. (0.5 mm).



158

Dimensions (mm) of valves and valve guides.

A. Intake.
B. Distance to be obtained by reaming fitted valve guide.
S. Exhaust.

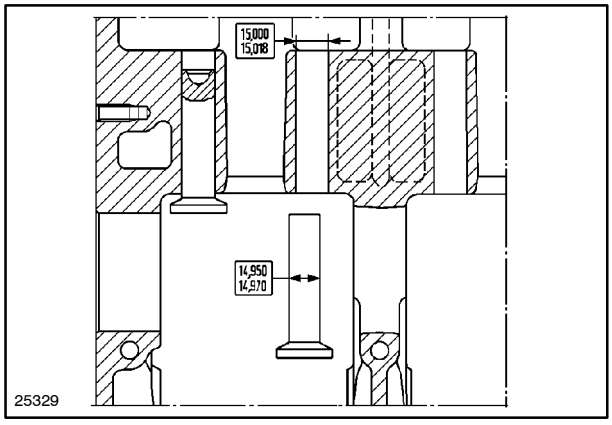
Tappets

Check that the tappets slide freely in their bores without excessive play.

When replacing the tappets, as a result of excessive bore clearance, fit oversize tappets (see page 18) and bore the seats.

Pushrods must be perfectly straight, and the concave contact surface with the rocker arm adjuster screw must not show signs of seizure or excessive wear, otherwise the rod must be replaced.

In the event of refacing of the contact surfaces, remove as little material as possible.



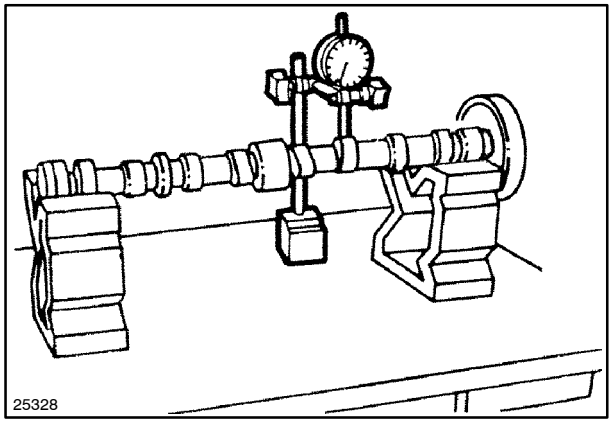
159

Camshaft

Position the camshaft on two parallel V blocks and, using a dial gauge with 0.04/3.94 in. (1/100 mm) scale, check that journal run-out relative to the axis of rotation does not exceed 0.01 in. (0.02 mm).

If run-out does not exceed 0.01 in. (0.02 mm), the camshaft may be straightened using a press; otherwise replace the camshaft.

Check cam lift using a dial gauge, which should be as follows:



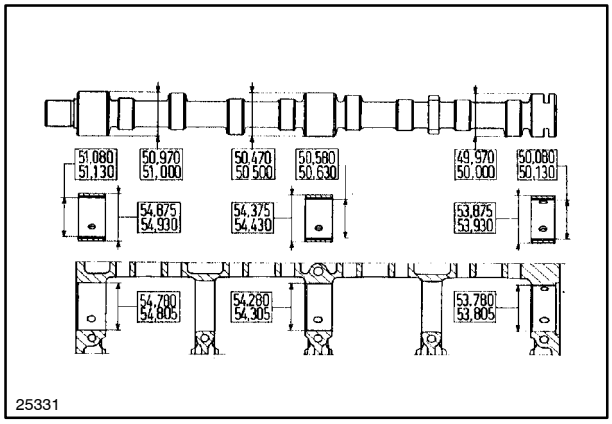
160

- **0.23 in. (5.97 mm) = intake valve;**
- **0.25 in. (6.25 mm) = exhaust valve.**

Replace worn bushings using suitable extractors and drifts, and ream to obtain the inside diameter shown in figure 161.

Dimensions (mm) of camshaft journals and relative seats in cylinder block.

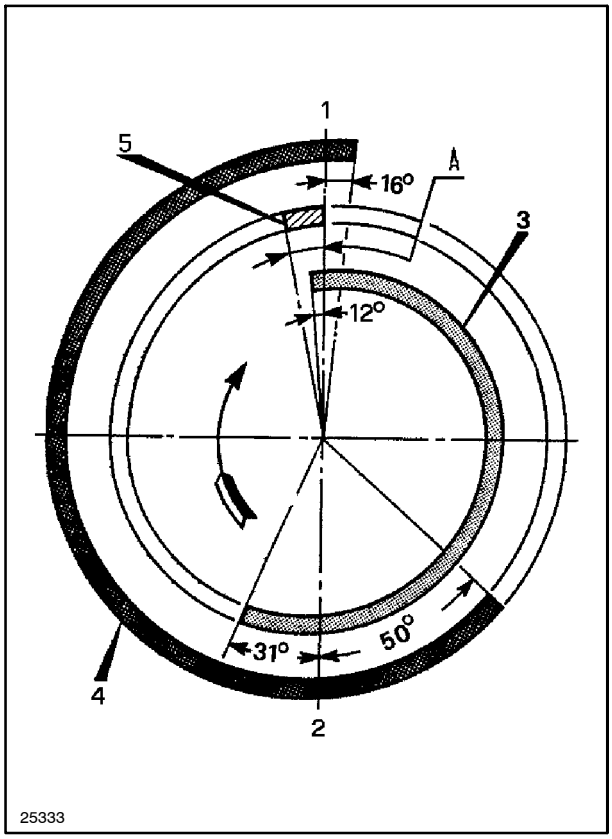
NOTE: *The value indicated for the bushing inside diameter refers to the fitted part.*



161

Valve timing check

To check the valve timing after dismantling/assembly or overhaul of the valve timing gear, proceed as follows:
Check the timing on the timing gears, as indicated on page 69.
Provisionally set valve clearances to 0.02 in. (0.45 mm).
Turn the crankshaft and, using a graduated timing disc, check that valves open and close at the angles indicated in the timing diagram.
Adjust the clearance between the valves and rocker arms as indicated on pages 100 and 101.



162

Valve timing diagram.

A. Fixed advance (*).
1. TDC.
2. BDC.
3. Inlet.
4. Exhaust.
5. Fuel injection.

NOTE: (*) See page 2 according to the type of engine and pump fitted on the tractor.

CHECKS, DIMENSIONS AND REPAIRS - CYLINDER HEAD

⚠ CAUTION ⚠

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

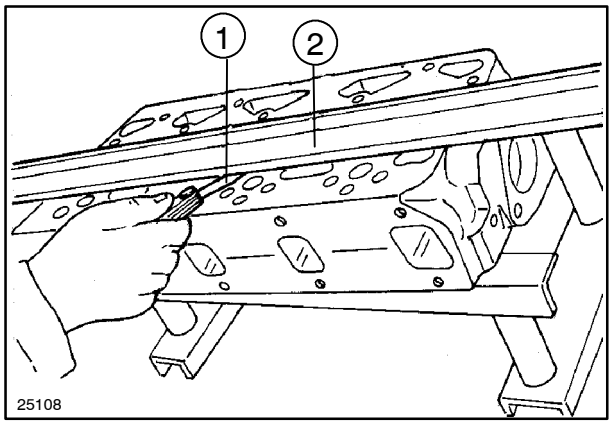
Use tool **380000302** to remove and refit valve springs.

Clean all parts carefully before proceeding with the operations described below.

Check that the cylinder head mating surface is flat using a straight edge (2) and feeler gauge (1).

If deviations of more than 0.006 in. (0.15 mm) are found, the head must be refaced.

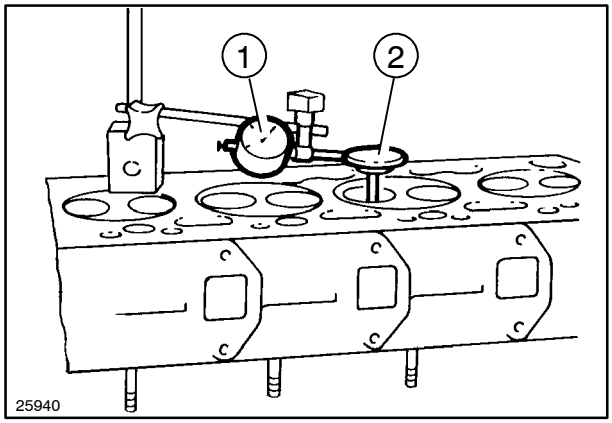
NOTE: *Remove as little material as possible: the maximum depth of material that can be ground from the cylinder head is 0.02 in. (0.5 mm).*



163

Using a dial gauge with magnetic base (1), check the run-out of the valve head (2) in the guide and the clearance between the valve stem and guide.

If the clearance exceeds the specified value, (see page 20) replace the valve and, if necessary, the valve guide.



164

CHECKS, DIMENSIONS AND REPAIRS - ROTATING COUNTERWEIGHT EQUALIZER

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

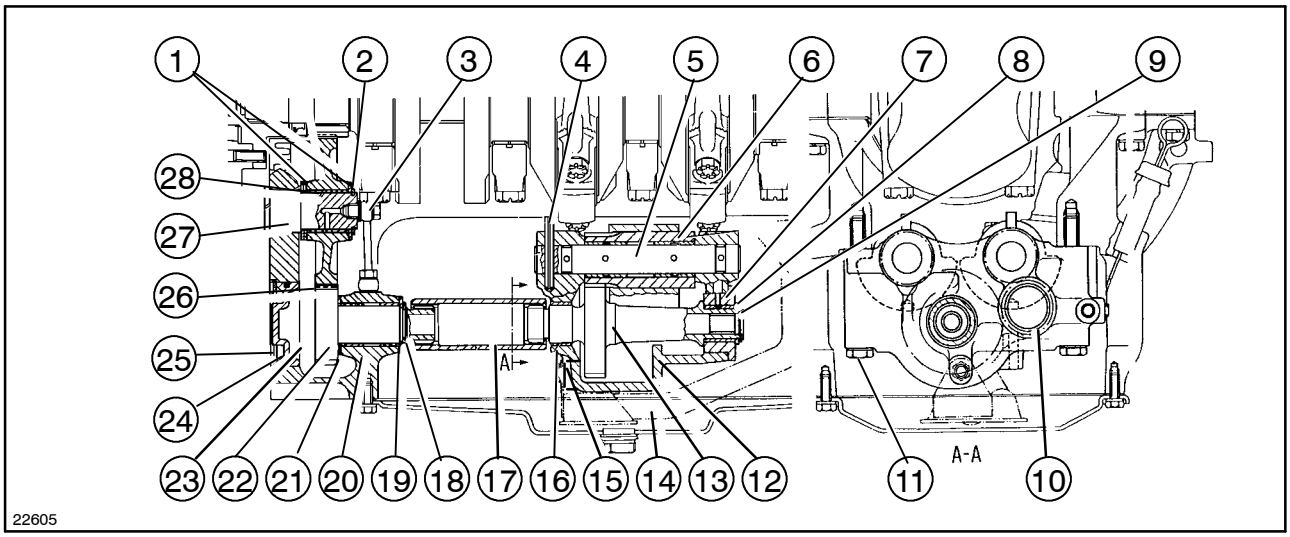
Wear suitable safety clothing - safety goggles, gloves and shoes.

Clean all parts carefully before proceeding with the operations described below.

Check components for wear, replacing parts that are in poor condition.

In the event of replacement, the bushings of the rotating counterweights must be driven into their seats after heating the counterweights in oil to a temperature of 284° to 320 °F (140° to 160 °C).

Rebore the insides of the replaced bushings, using an expandable-blade reamer, the fit should be within the tolerance range shown on page 19.



165

Cross-sectional view of equalizer device.

1. Washers.
2. Retaining snap ring.
3. Bush lubrication pipe (28).
4. Spindle retaining pin (5).
5. Rotating counterweight spindle.
6. Counterweights.
7. Counterweight gear unit support (13).
8. Fifth wheel.
9. Retaining snap ring.
10. Counterweight intermediate gear unit.
11. Counterweight/sump retaining bolts.
12. Counterweight casing.
13. Counterweight gear unit.
14. Rose pipe.
15. Rose pipe retaining bolt.
16. Bush.
17. Rigid connecting sleeve.
18. Retaining snap ring.
19. Fifth wheel.
20. Gear mounting (22).
21. Fifth wheel.
22. Counterweight drive gear unit.
23. Seal cover.
24. O-Ring seal.
25. Retaining snap ring.
26. Idler gear.
27. Gear unit rotating spindle (26).
28. Bush.

CHECKS, DIMENSIONS AND REPAIRS - LUBRICATION SYSTEM

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

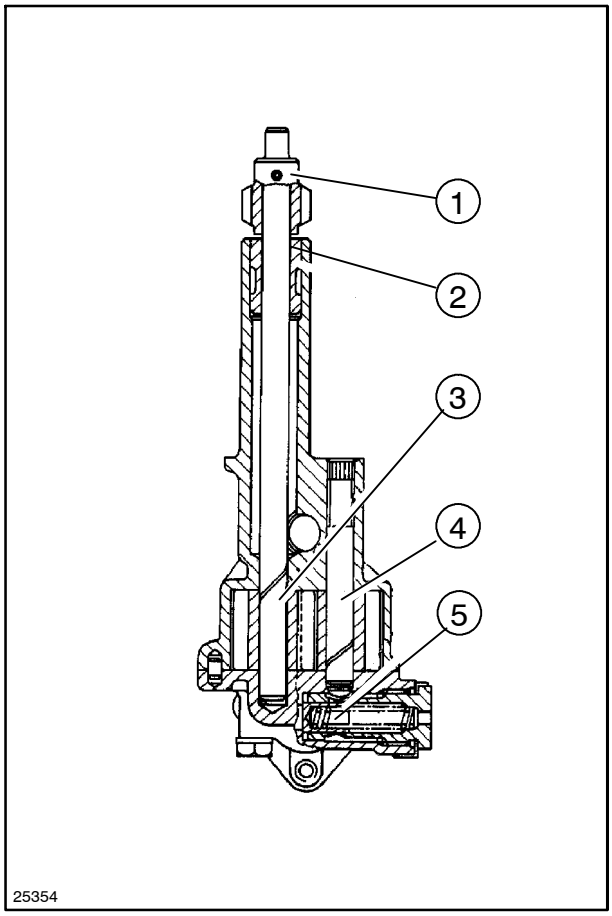
Clean all parts carefully before proceeding with the operations described below.

OIL PUMP - Overhaul

To access the oil pump, remove the sump pan.

When servicing the pump, check component wear against the dimensions specified in the table on page 21.

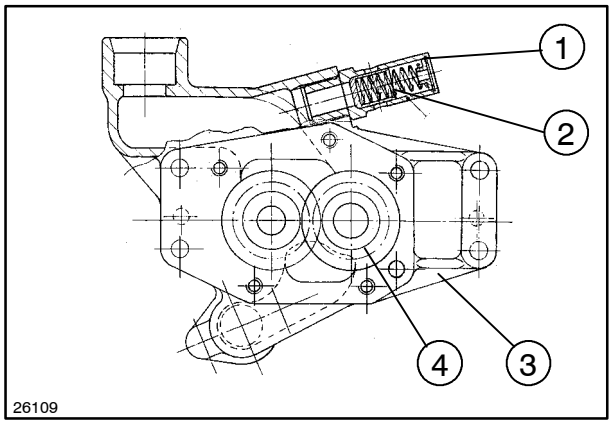
If changing, bear in mind that the driving shaft (3) and its gear are supplied paired, since the gear is heated to be forced onto the shaft.



166

Cross-sectional view of engine lubricating oil pump for models TL70 and TL80.

1. External drive gear.
2. Bush.
3. Drive shaft and gear.
4. Driven shaft and gear.
5. Pressure relief valve.



167

Cross-sectional view of engine lubricating oil pump for models TL90 and TL100.

1. Pressure relief valve.
2. Spring.
3. Pump Body.
4. Internal gears.

OIL FILTER - Replacement

The oil filter (3, fig. 5) is of the full-flow, integral paper cartridge type, and is installed on the pump delivery line.

If the filter gets too clogged, the safety valve (2) opens to enable the oil to by-pass the filter, keeping the engine lubricated, albeit with non-filtered oil.

Replace the cartridge periodically (every 300 operating hours), remembering to:

- oil the outer part of the seal in contact with the mounting on the crankcase;
- screw on the new cartridge until the seal is up against the mounting;
- tighten the cartridge, **by hand only**, through a further 3/4 turn.

LOW OIL PRESSURE INDICATOR - Functional checks

The indicator consists of a control switch (4, fig. 5) and a red pilot lamp on the dashboard, which illuminates under the following circumstances:

- low oil pressure (the warning lamp also illuminates in normal conditions, with no faults present, when the engine is hot and idling at low speed);
- control switch malfunction.

If the red lamp fails to illuminate when the engine is stopped and the ignition switch is turned to the power ON position, the possible causes are:

- blown fuse;
- blown lamp;
- interruption in wire to the control switch.

CHECKS, DIMENSIONS AND REPAIRS - COOLING SYSTEM

Clean all parts carefully before proceeding with the operations described below.

The cooling system is supplied with a permanent coolant mixture consisting of water and **"AMBRA AGRIFLU"** antifreeze (up to 50% in volume). This mixture prevents freezing down to the following temperatures:

Degrees °F (°C)	17.6 (-8)	5 (-15)	-13 (-25)	-31 (-35)
% in volume of **"AMBRA AGRI-FLU"**	68 (20)	86 (30)	104 (40)	122 (50)

This mixture also has anti-oxidant, anti-corrosion, anti-foaming and anti-scaling properties to ensure long-term protection of the cooling system.

The same mixture can be kept in the cooling system for a maximum of 2 years or 1600 operating hours, whichever comes sooner; after which it must be changed.

RADIATOR - Flushing and checks

Two valves are built into the radiator cap, one compression valve and one depression valve. Check the correct operation of the valves periodically.

When overhauling, remove deposits of lime scale in the radiator by means of a solution of water and **descaling agent** in the proportions shown on the container.

It is never advisable to limit flushing to the radiator only - always extend it to the entire cooling circuit and top up the engine with the solution referred to above.

Run the engine for about an hour (with the engine off) in order to drain the solution through the drain plug.

In the event of leakage, the radiator is checked by immersing it in a tank of water at a temperature of 68 to 104 °F (20 to 40 °C), introducing air into the radiator at a pressure of 14.21 psi (0.98 bar) for approximately two minutes (repeat the test at least three times).

COOLANT THERMOMETER - Testing

If malfunction is suspected, immerse the bulb of the thermometer in water and check the readings against a test thermometer (repeat the test a number of times with different water temperature to be sure).

THERMOSTAT - Replacement

The thermostat (1, fig. 6) is fitted in the cylinder head coolant outlet union.

The thermostat cannot be adjusted and therefore must be replaced if it does not meet the temperature specifications in the table on page 3.

Op. 10 101 53
VALVE GUIDES
Replacement

DANGER

Lift and handle all heavy parts using suitable lifting equipment.

Make sure that assemblies or parts are supported by means of suitable slings and hooks.

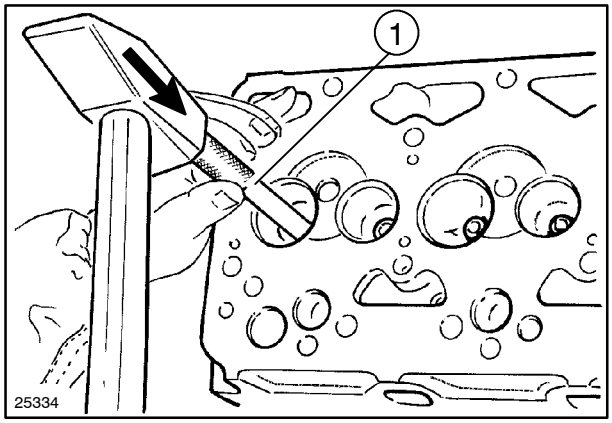
Check that no one is in the vicinity of the load to be lifted.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

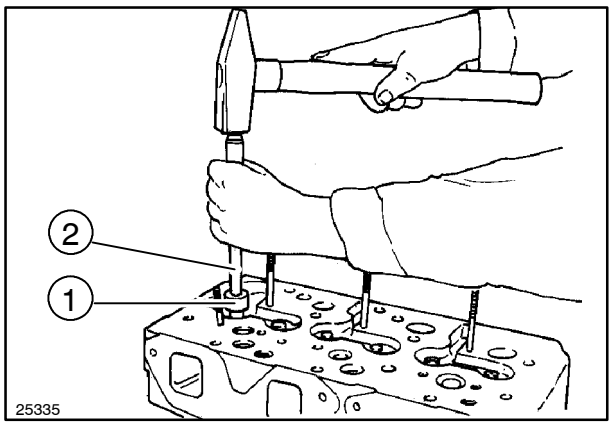
With the cylinder head on the test bench, proceed as follows:

1. Enlarge the bore of the valve guide to be fitted, using twist drill **380000276**.
2. Place the cylinder head on a suitable support and remove the valve guide to be replaced using drift **380000219** (1).



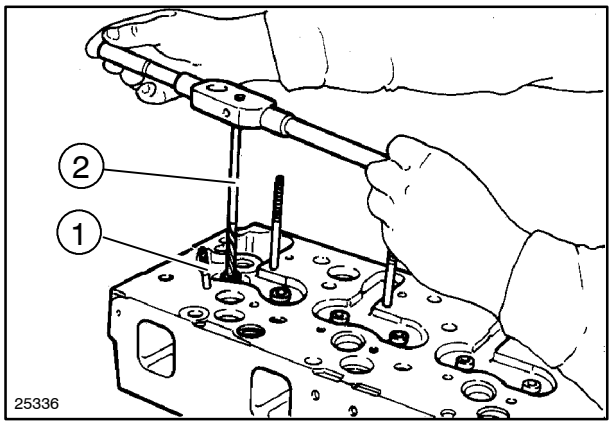
168

3. Turn the head upside down, and force fit the new valve guide with the enlarged bore, using drift **380000219** (2) and bush **380000242** (1).



169

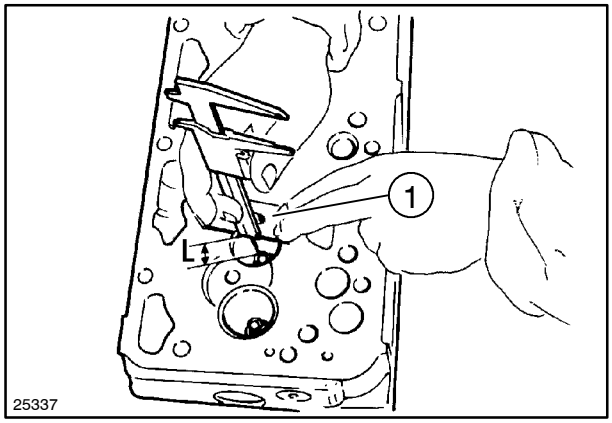
4. Using the reamer **380000242** (2), ream out the valve guide bore (1).



170

NOTE: *when replacing exhaust valve guides, proceed with the following operations.*

5. Measure the distance (L) between the cylinder head face and the base of the valve guide, using a calliper gauge and special plate (1) on tool **380000277**.



171

The depth of taper milling is given by:

B – L = C

where:

B = depth of taper relative to cylinder head face (see fig. 178).

L = distance measured between cylinder head face and valve guide base.

C = depth of taper milling.

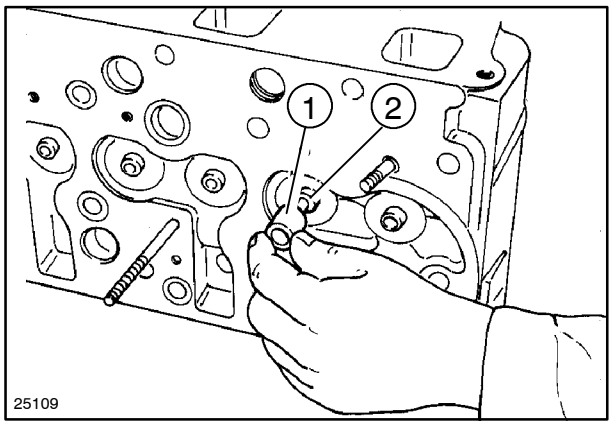
Example

B = 1.70 to 1.72 in. (43.1 to 43.6 mm)

L = 1.34 in. (34 mm). Value measured.

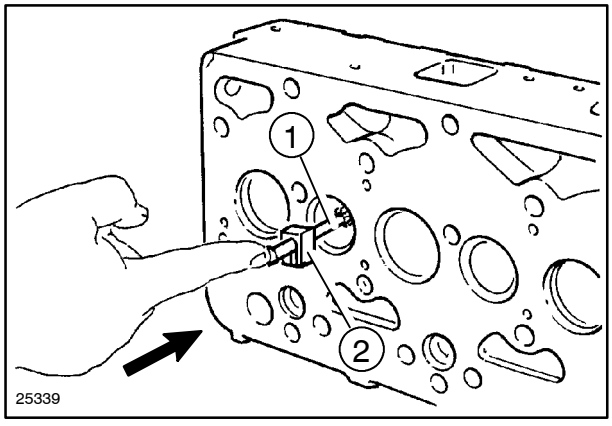
C = (1.70 to 1.72 in.) – 1.34 in. = 0.36 to 0.38 in. [(43.1 to 43.6) – 34 = 9.1 to 9.6 mm]. Depth of taper milling.

6. From the upper side of the cylinder head, fit guide bush (1) of tool **380000277** on the guide valve to be milled (2).



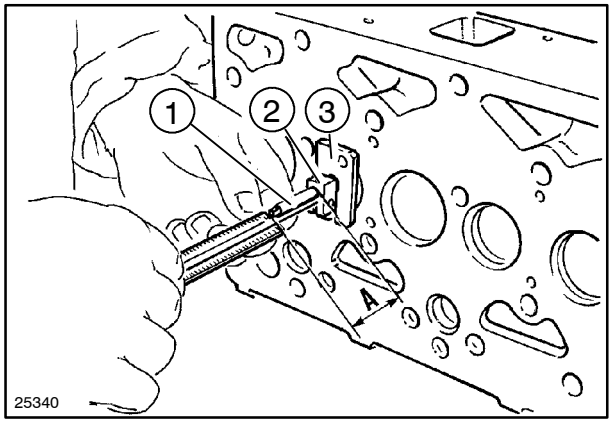
172

7. Slide the cutter (1) of tool **380000277**, complete with depth stop (2), into the previously located guide bush until the cutting head is in contact with the valve guide.



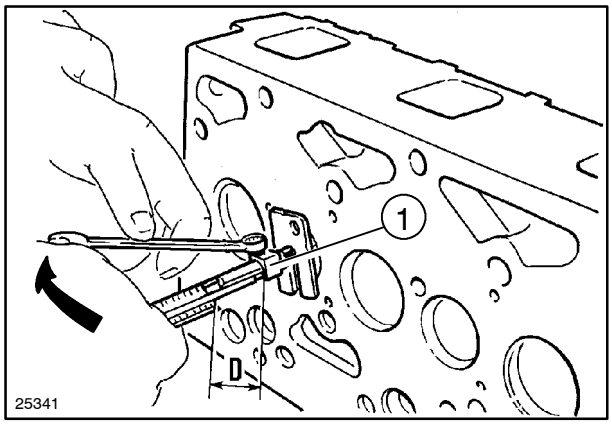
173

8. Position the plate (3) of tool **380000277** flush against the cylinder head face and slide the depth stop (2) up to the plate. Measure the distance (A) between the depth stop and the end of the cutter shank (1).



174

9. Position the depth stop (1) at a distance (D) = 1.41 to 1.43 in. (35.9 to 36.4 mm) from the end of the cutter shank and fix in place with its set screw.



175

The distance (D) is given by:

D = A - C

where:

D = the distance determining the end of the taper milling.

A = the distance between the end of the cutter shank and the depth stop, with the plate flush against the cylinder head.

C = the depth of taper milling.

Example

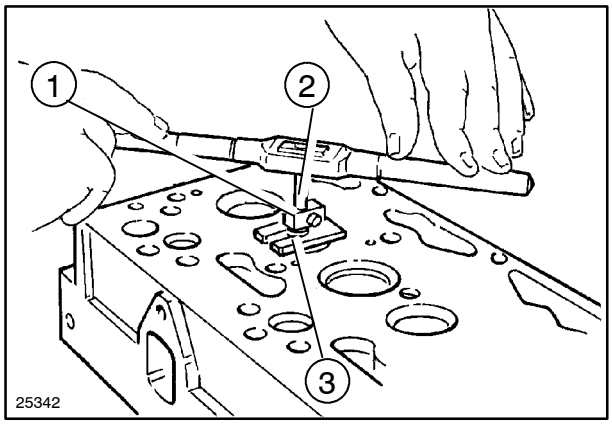
A = 1.79 in. (45.5 mm)

C = 0.36 to 0.38 in. (9.1 to 9.6 mm)

D = 1.79 - (0.36 to 0.38) = 1.41 to 1.43 in.
[45.5 - (9.1 to 9.6) = 35.9 to 36.4 mm]

10. Turn the cutting tool (2) until the plate (3) is brought up to the cylinder head face by the depth stop (1).

NOTE: *Before fitting the cylinder head, clean thoroughly to remove all residue from the milling operation.*



176

VALVE SEATS ON CYLINDER HEAD

Reboring

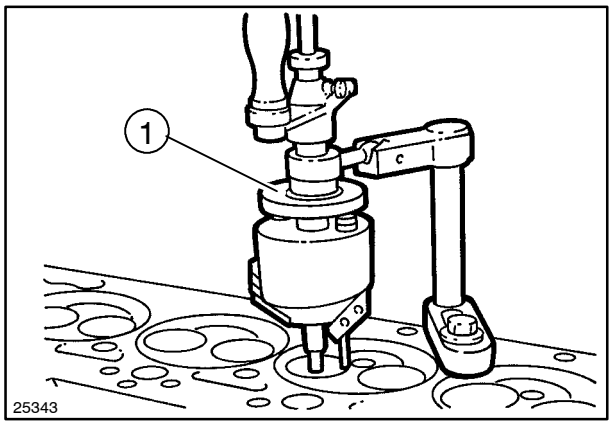
CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

11. If it is necessary to regrind the valve seats on the cylinder head, to obtain the best seal, use the universal grinder (1) removing as little material as possible.



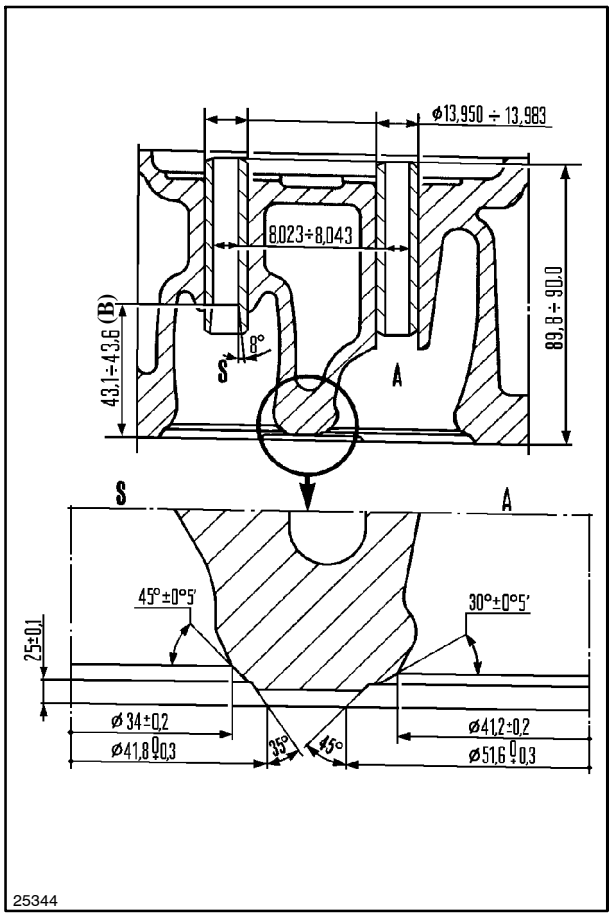
177

Dimensions (mm) of valve seats and valve guides.

A. Intake.

B. Depth of taper.

S. Exhaust.



178

Op. 10 101 60
INJECTOR SLEEVE
Replacement

CAUTION

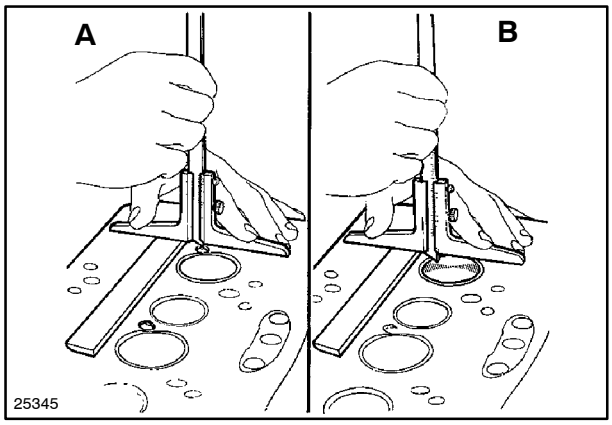
Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

1. If the cylinder head face has been reground, check the injector stand-out is within the tolerance limits specified below.

Checking the position of the injectors and valves in relation to the cylinder head block.

A. Checking injector stand-out: 0.011 to 0.043 in. (0.3 to 1.1 mm).

B. Checking valve stand-in: 0.027 to 0.039 in. (0.7 to 1.0 mm) [(max. permissible stand in = 0.051 in. (1.3 mm)].



179

If injector stand-out exceeds the specified limit, replace the injector sleeve using tool kit **(380000246)**, proceeding as follows:

2. Set distance (A) on tap (3, fig. 180) **292240** to 0.35 in. (9 mm) by means of ring nut (5) and fix the ring nut in position by tightening the set screw (4).

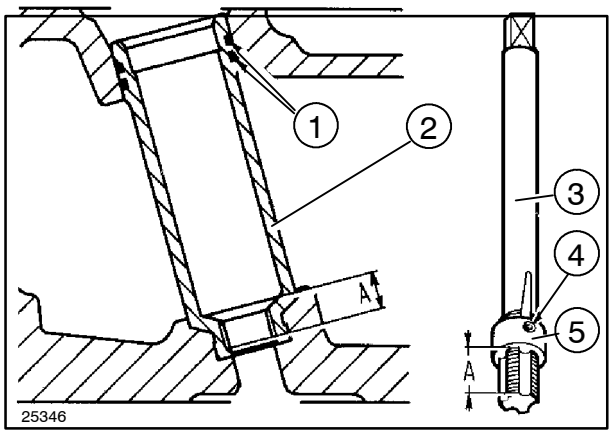
3. Cut an internal thread (2) in the sleeve to be removed using tap **292240** (3, fig. 180) M 12 x 1.75 making sure that the thread is cut only in the sleeve.

4. Fit tool **293784** (2, fig. 182) to the injector mounting studs on the cylinder head by means of the M8 x 1.25 nuts (3).

5. Screw part (11) fig. 182) fully into the previously cut thread and turn nut (1) to withdraw the injector sleeve (12) from the head.

6. Remove any copper residue from inside the head using tool **292243** (4, fig. 182).

7. Fit seals (6) fig. 182) onto the new injector sleeve and fit the sleeve into its bore, making sure that the sleeve butts up against the bottom of the seating in the cylinder head, and dress with dressing tool **293861** (5).

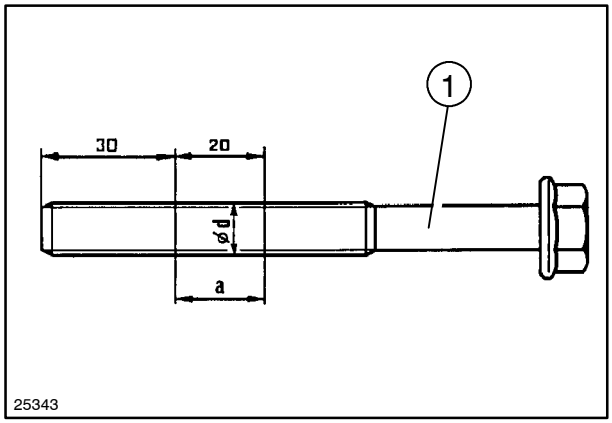


180

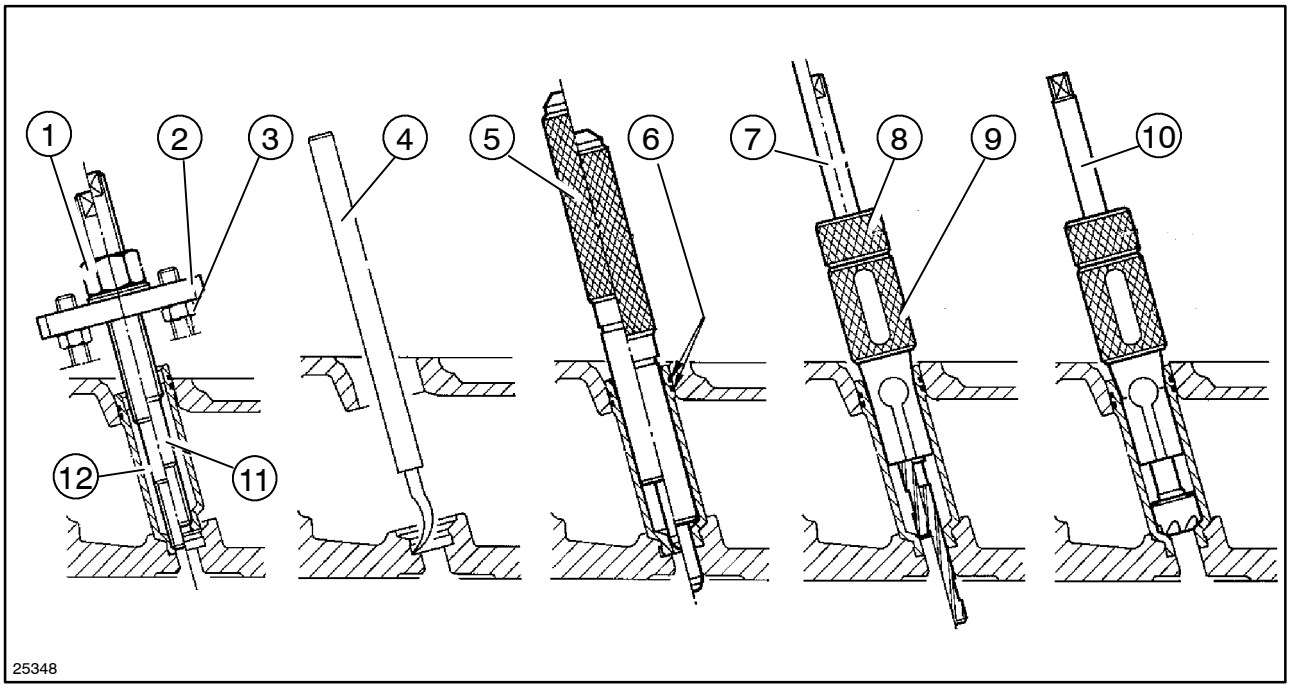
8. On the new injector sleeve (12, fig. 182), fit guide bush **293746** (9), securing it in position by turning the ring nut (8) clockwise. Insert reamer **293747** (7) in guide bush (9) and then ream the lower part of the sleeve.
9. Remove the reamer (7, fig. 182) and unscrew the ring nut (8) by approx. 0.39 in. (10 mm).
10. Press by hand on the ring nut (8, fig. 182) or tap gently with a rubber mallet, to release the inside of the guide bush (9) **293746**.
11. Remove the guide bush, and fit the milling cutter **293790** (10, fig. 182) in the bush. Install the bush in the sleeve (12) and fix in position by turning the ring nut (8) clockwise.
12. Work with the cutter (10, fig. 182) to remove material until the seating is perfectly smooth and free from all marks.
13. Once completed, remove the cutter, fit the injector in the sleeve (12, fig. 182) and check that stand-out is as specified on page. 20.

Cylinder head bolts (1, fig. 181)

If the bolts are to be re-used, check that diameter **d** (measured in area a shown in the figure) is greater than 0.45 in. (11.5 mm); if not, use new bolts.



181



182

Disassembly, removal of residue, installation and reaming of injector sleeve in cylinder head using tool kit 380000246.

1, 2 and 11. Injector sleeve extractor **293784**.
3. M8 x 1.25 injector retaining nuts.
4. Waste removal tool **292243**.
5. Injector sleeve dressing tool **293861**.
6. O-ring seals.
7. Reamer **293747**.
8, 9. Guide bush **293746**.
10. Cutter **293790**.
11. Injector sleeve extractor **293784**.
12. Injector sleeve.

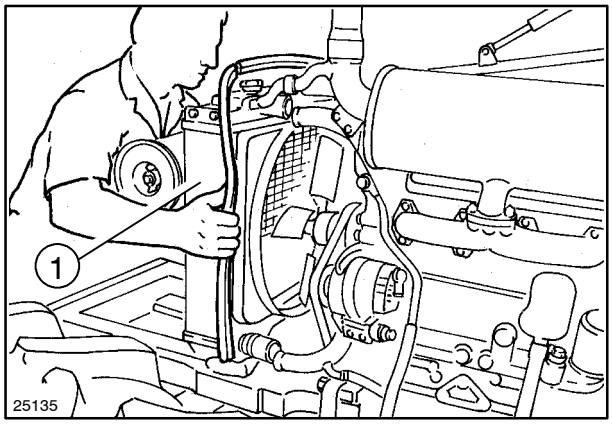
Op. 10 102 70
CRANKSHAFT FRONT SEAL
Replacement

DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

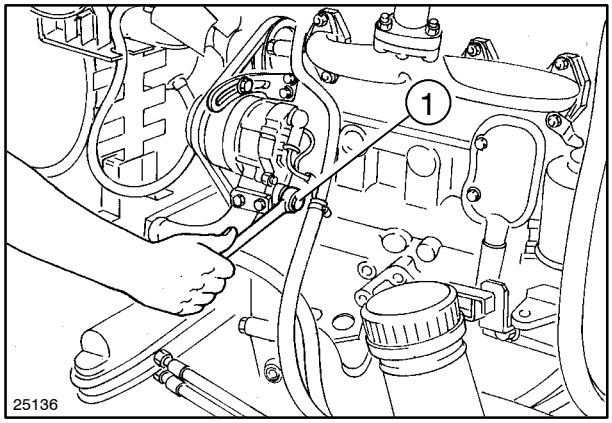
To access the seal, proceed as follows:

1. Remove the radiator (1), as indicated in operation **10 406 10** on page 121.



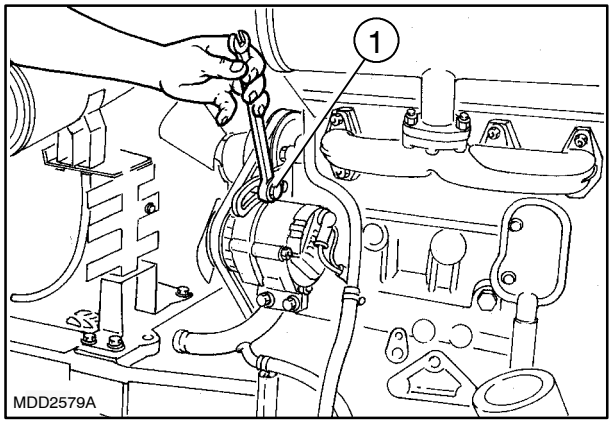
183

2. Loosen the alternator pivot bolt (1) on the relative support.



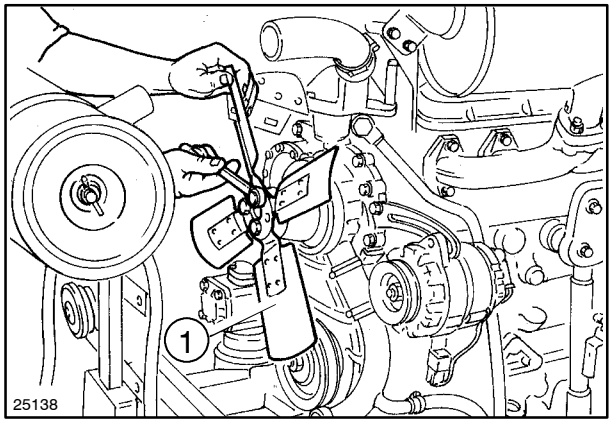
184

3. Loosen the belt tension bolt (1) and remove the belt.



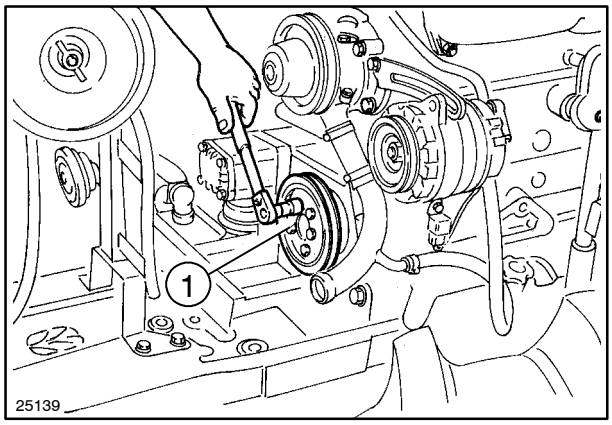
185

4. Remove the radiator cooling fan (1).



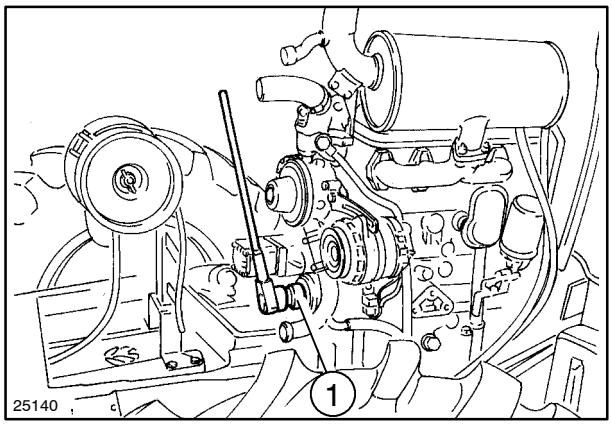
186

5. Take out the retaining bolts (1) and remove the fan-alternator drive pulley.



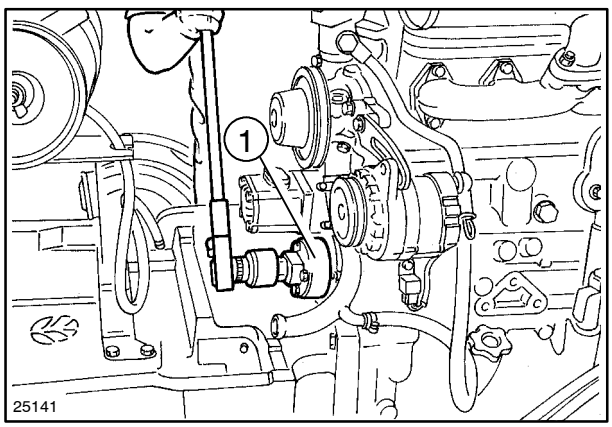
187

6. Straighten the lock tab and remove the nut (1), securing the crankshaft against rotation.



188

7. Extract the crankshaft pulley support hub, using tool **380000226** (1) and recover the Woodruff key.



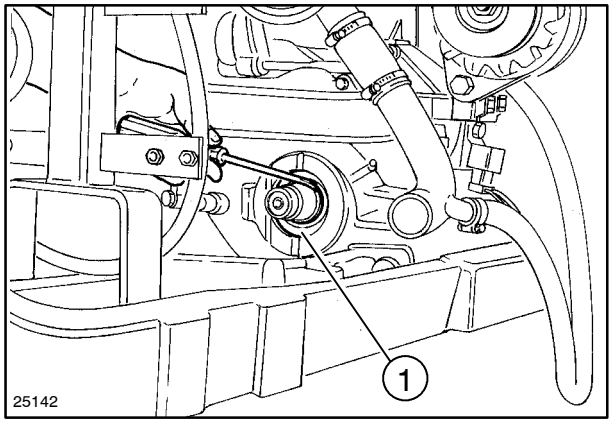
189

8. Remove the oil seal (1).

9. To refit, proceed as follows:

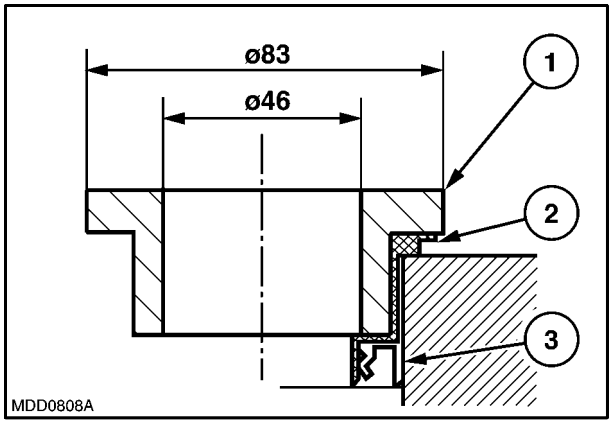
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



190

To fit the front seal on the crankshaft, proceed as follows:



191

- Insert the crankshaft front seal (3) on the seal chock (2) and, using tool (1) **50138**, see page 24, insert the seal (3).

- On completion, extract the splining tool (1) and the chock (2), leaving the seal (3) in position.

- Assemble the Woodruff key, fit the hub in position and secure the nut lock tab.

- Refit the cooling fan.

- Refit the drive belt and adjust, securing the alternator.

- Refit the radiator, as indicated on page 124.

- Refill with coolant.

- Hitch the bonnet to a hoist and fit on the rear pivot bracket, connect the front lights electrical connection.

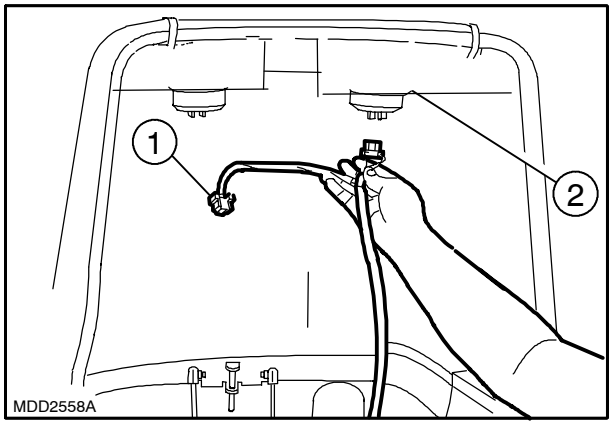
- Reconnect the negative battery cable and close the bonnet.

Op. 10 106 12
VALVE-ROCKER ARM CLEARANCE
Adjustment

CAUTION

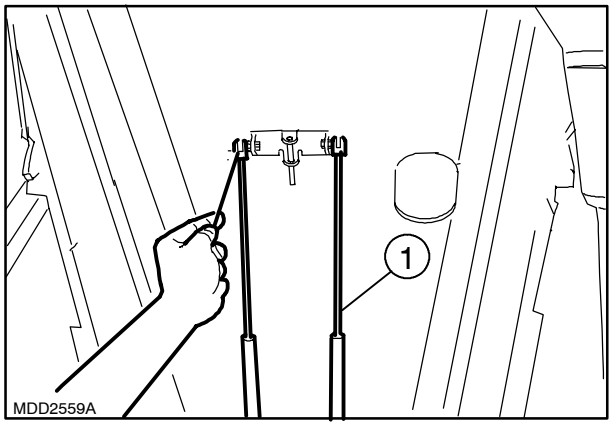
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Disconnect the battery negative cable (A).
2. Remove the exhaust pipe, raise the bonnet and disconnect the front headlight (2) connections (1).



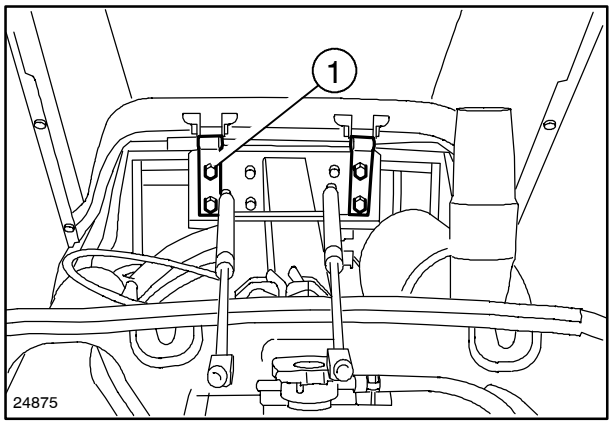
192

3. Remove the gas spring (1) from the bonnet.



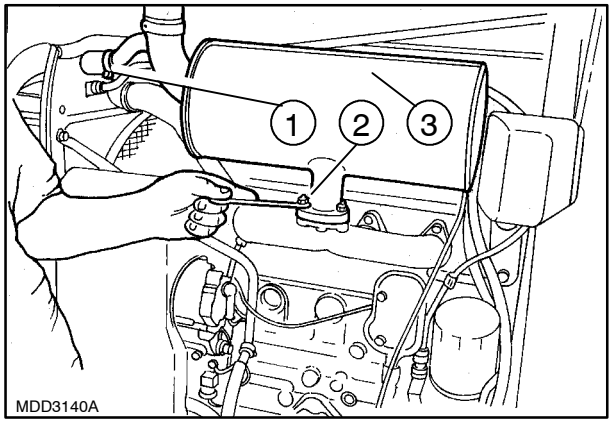
193

4. Unscrew the four bolts (1) retaining the hinge bracket and remove the bonnet.



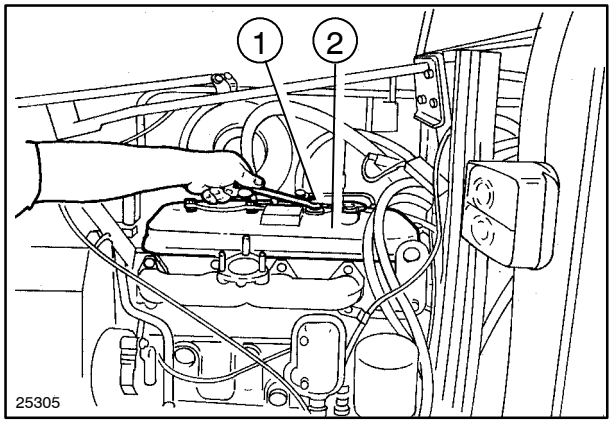
194

5. Remove the clamp (1) and extract the hose from the ejector.
6. Remove the exhaust silencer front support retaining bolts.
7. Unscrew the exhaust silencer/exhaust manifold retaining nuts (2) and remove the part (3).



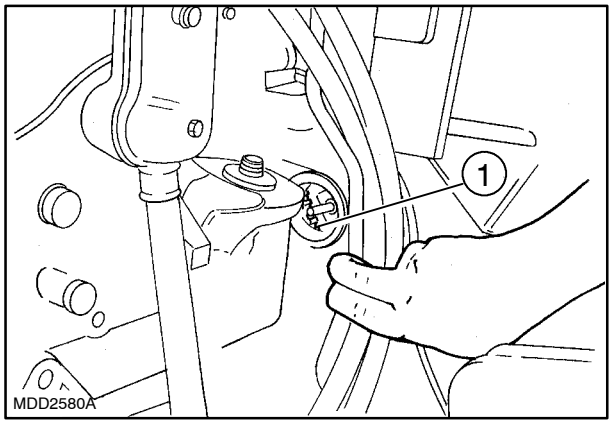
195

8. Unscrew the four retaining nuts (1) and remove the rocker arm guard cover (2).



196

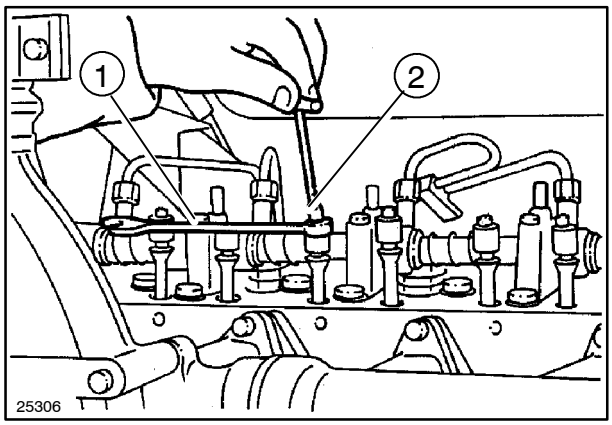
9. Remove the flywheel inspection window cover (1).



197

10. Adjust the clearance between the valves and the rocker arms using a feeler gauge, wrench (1) and rocker adjustment tool **380000232** (2), bearing in mind the following recommendations.

NOTE: *Before proceeding with adjustment operations, position the valves as described on the following pages.*



198

To carry out adjustments on 4-cylinder models proceed as follows:

- Rotate the crankshaft so that the inlet and exhaust valves of cylinder No. 1 are balanced (start of induction stroke). In this position the pointer will be aligned with the reference mark on the TDC 1 on the flywheel.

- Check that the clearance between the valves and rocker arms of symmetrical cylinder No.° 4, is the same as the value shown in the table on page 19. Rotate the flywheel through 360° and adjust cylinder No.° 1.

- Repeat this operation for the other valve pairs, bearing in mind that the symmetrical cylinders are 1-4 and 3-2.

For assembly operations proceed as follows:

- Refit the rocker arms cover.

- Refit the lateral cover which provides access to the flywheel toothing.

- Refit the exhaust silencer.

- Refit the bonnet and front headlight electrical connections.

- Reconnect the battery negative cable.

Op. 10 218 30
ENGINE INJECTOR R.I.

⚠ CAUTION ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

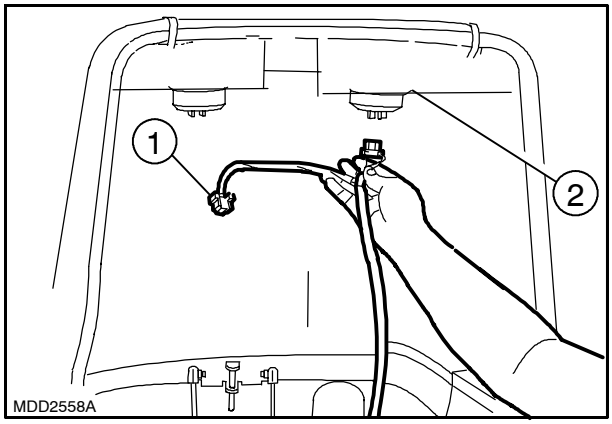
⚠ CAUTION ⚠

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

Proceed as follows:

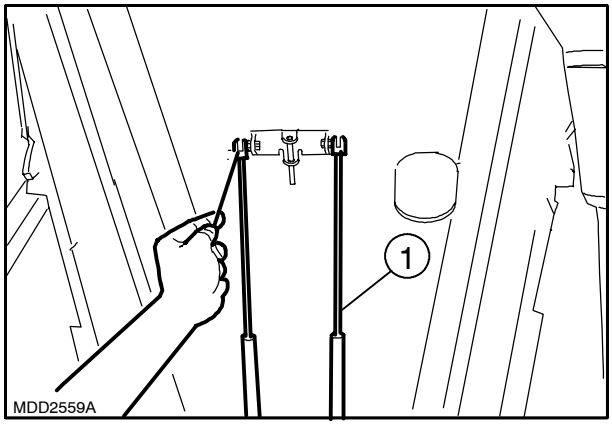
1. Disconnect the battery negative cable (A).

2. Remove the exhaust pipe, raise the bonnet and disconnect the front headlight (2) connections (1).



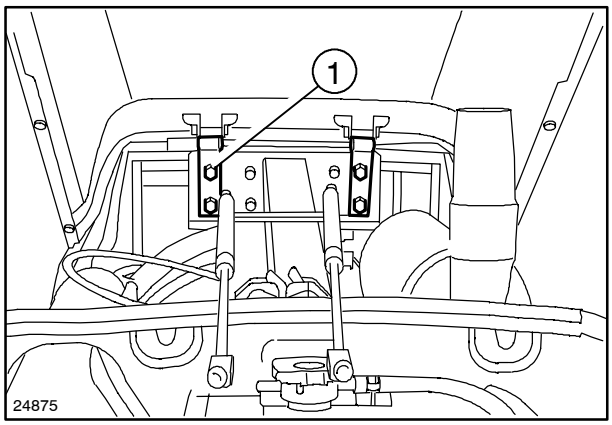
199

3. Remove the gas spring (1) from the bonnet.



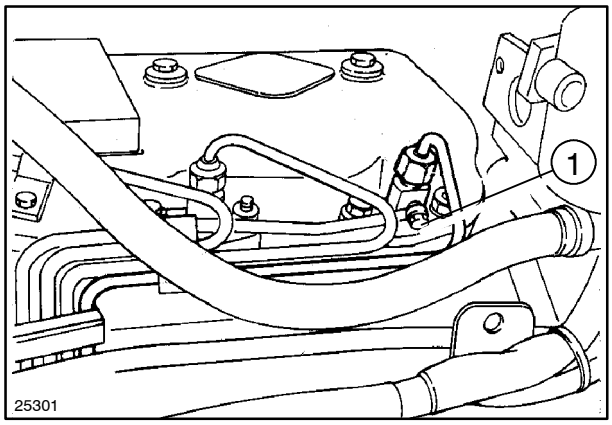
200

4. Unscrew the four bolts (1) retaining the hinge bracket and remove the bonnet.



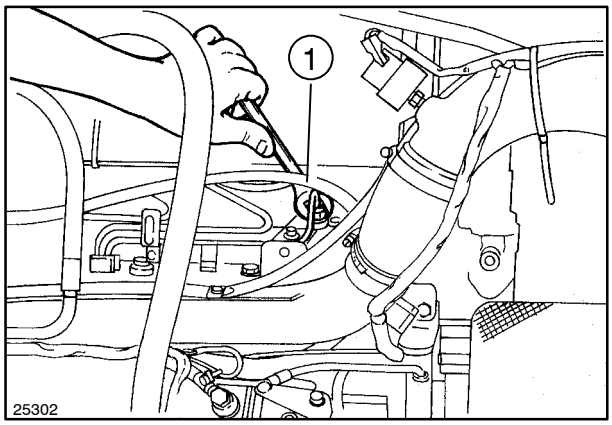
201

5. Unscrew the fuel recovery union (1) on the injector.



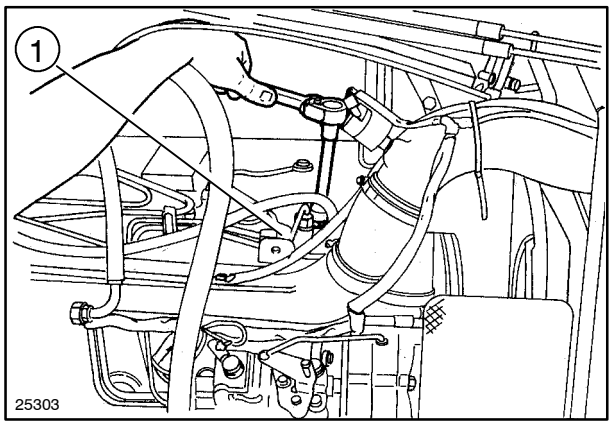
202

6. Unscrew the fuel delivery union (1) on the injector.



203

7. Unscrew the two nuts (1) on the retaining bracket and remove the injector.



204

8. To refit, proceed as follows:

CAUTION

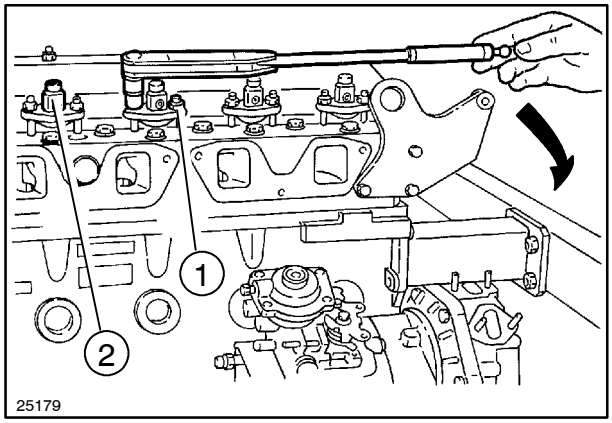
Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Insert the injectors (2) in their respective bores.

- Position the injector support brackets and fit the spherical washers.

- Screw the bracket retaining nuts (1) up to the spherical washers then, using a torque wrench, tighten to the torque specified on page 22 in two stages:

  1st stage, tighten the nuts to 10 Nm (1 kgm):
  2nd stage, tighten the nuts to 25 Nm (2.6 kgm).



205

- Tighten the injector leak-off pipe unions.

- Tighten the high-pressure fuel line unions.

- Refit the bonnet.

- Reconnect the battery negative lead.

Op. 10 246 14
BOSCH INJECTION PUMP R.I.

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

CAUTION

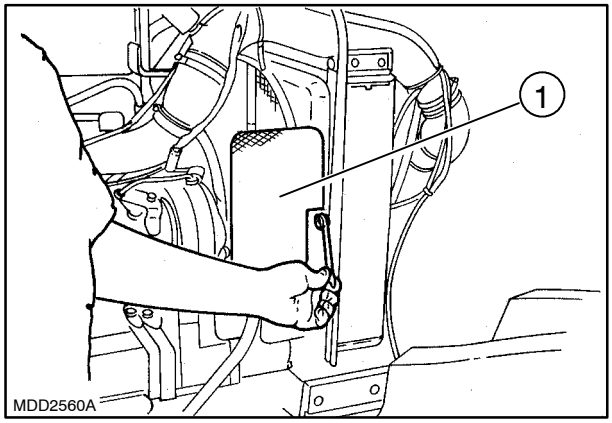
Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

Proceed as follows:

1. Disconnect the battery negative cable (A).

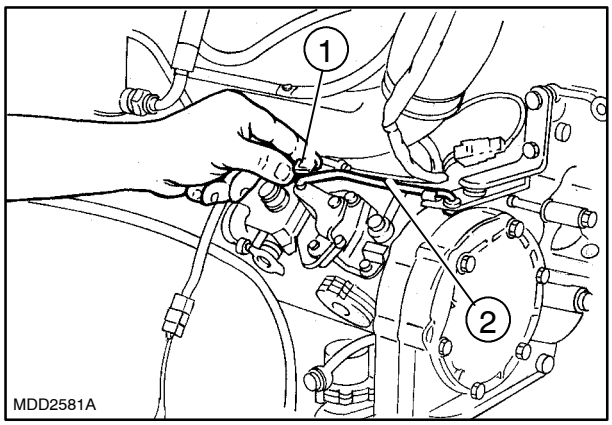
2. Remove the exhaust pipe and raise the bonnet.

3. Remove the RH lateral guard (1) by unscrewing the three retaining bolts.



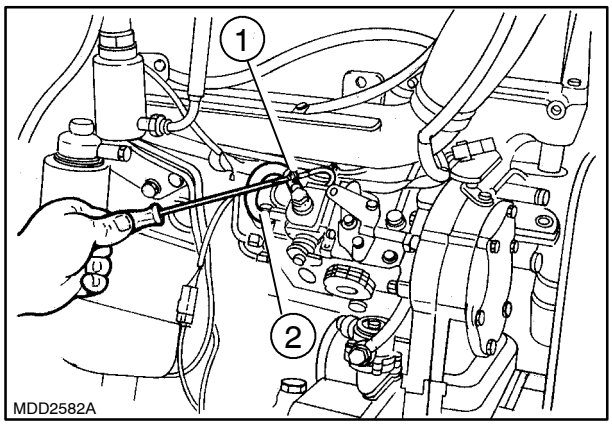
206

4. Remove the accelerator retaining spring (1) and extract the lever (2).



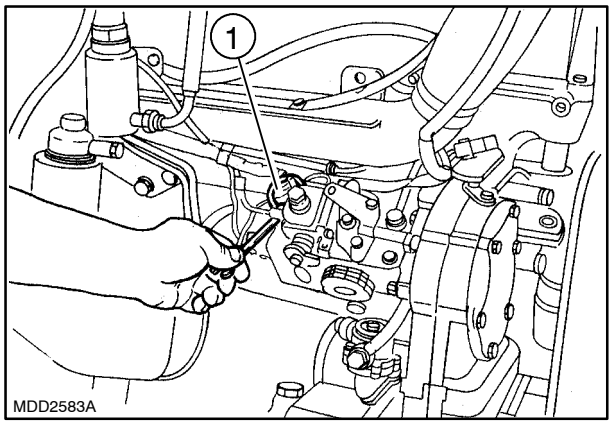
207

5. Remove the clamp (1) and extract the hose (2) connected to the thermostarter device.



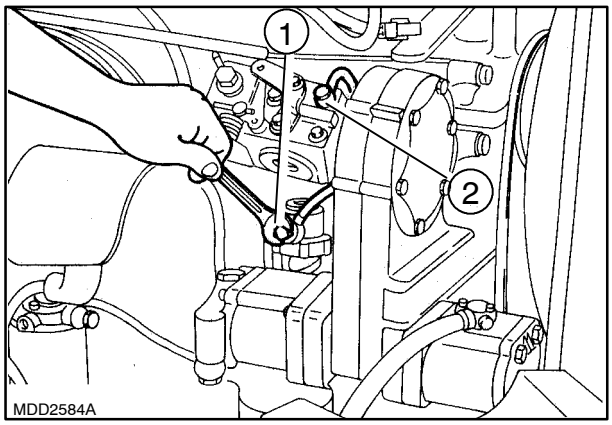
208

6. Disconnect the engine stop electromagnet wire (1).



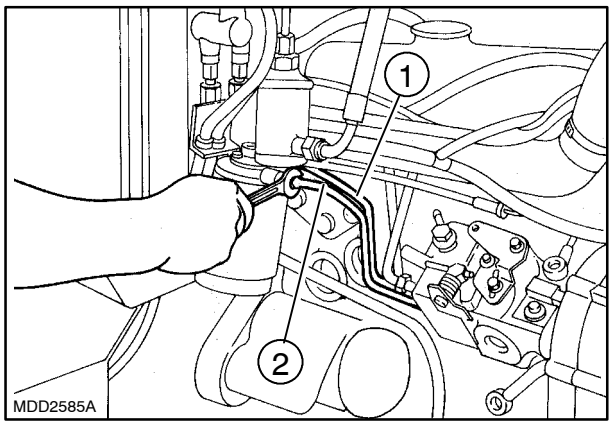
209

7. Unscrew the union (1) on the fuel pump and the union (2) on the injection pump.



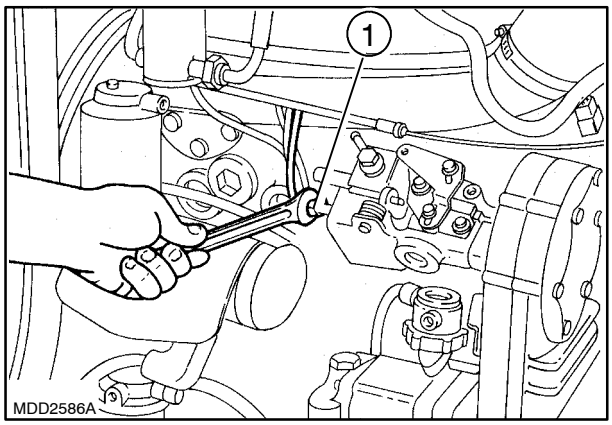
210

8. Unscrew the unions on the fuel filter and remove lines (1) and (2).



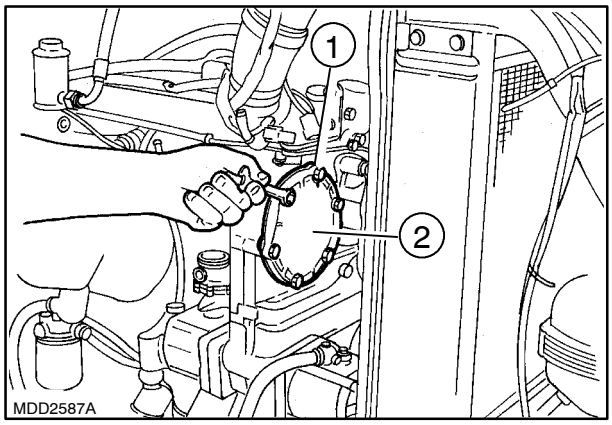
211

9. Unscrew the injection pump/injectors unions (1) and remove the lines.



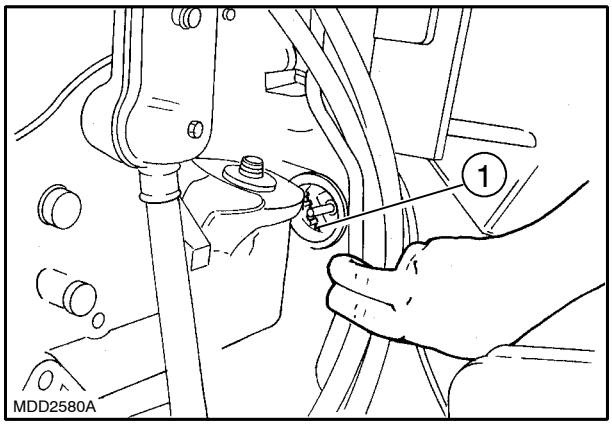
212

10. Take out the bolts (1) securing the cover (2) of the injection pump drive gear.



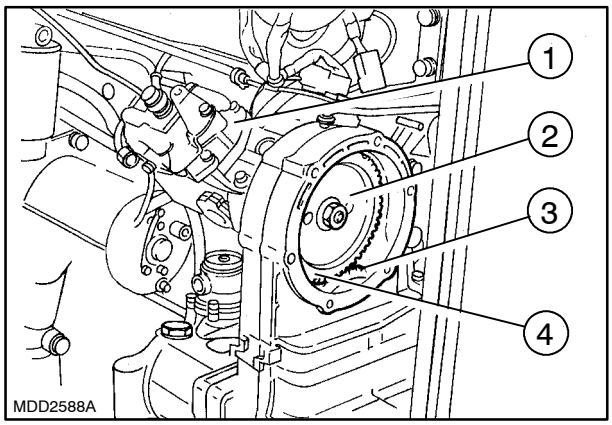
213

11. Remove the access cover to the flywheel gears (1).



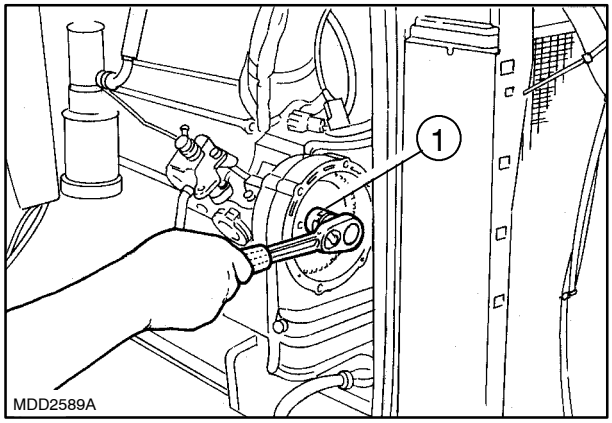
214

12. Turn the flywheel, using suitable equipment, so the two reference marks (4) stamped on the gears (2) and (3) coincide in order to have visual control over gear timing on installing the pump (1).



215

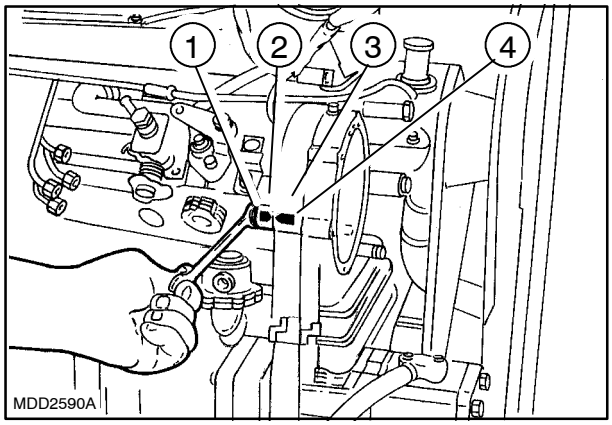
13. Unscrew the injection pump shaft locknut (1) on the relative gearing.



216

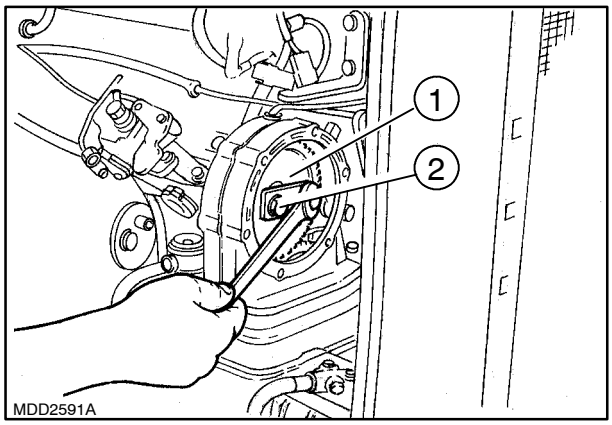
NOTE: *Before taking down the pump (2), check that the timing reference marks (4) stamped on the casing (3), on the pump (2), are easy to see.*

14. Unscrew the injection pump retaining nuts (1) from the distribution casing.



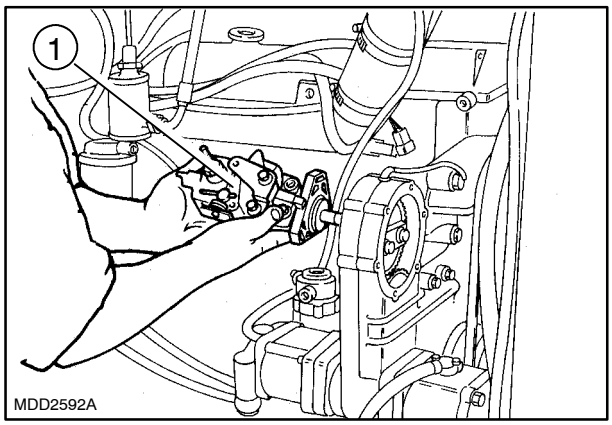
217

15. Extract the injection pump gear unit (1) using tool **380000322** (2).



218

16. Remove the injection pump (1).



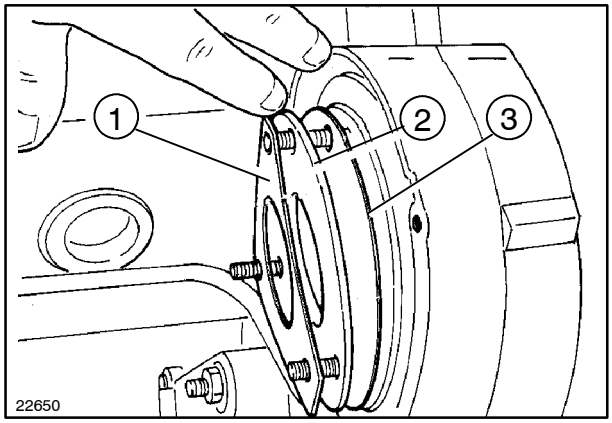
219

17. Remove seal (1), spacer (2) and seal (3).

18. To refit the injection pump, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



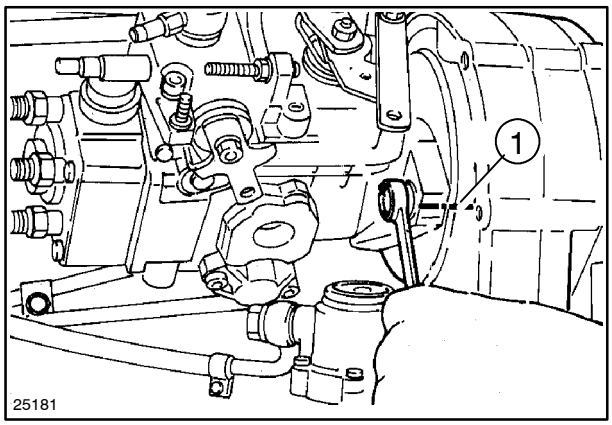
220

- Respect the tightening torques prescribed on page 22.
- When refitting the BOSCH injection pump, make sure that the timing reference marks (4, fig. 217) stamped on the pump (2) and guard (3) are aligned.
- Fit the pump gear unit in the conical seat (2, fig. 215), making sure that the timing reference marks (4) stamped on the gears (2 and 3) are aligned then secure with the nut. Tighten the three pump retaining nuts.
- Refit the gear front cover.
- Reconnect the two injection pump/filter and fuel pump/filter hoses, after having fitted the unions on the filter.
- Connect the engine stop wire and reconnect the high-pressure lines on the pump and the injectors.
- Fit the accelerator lever/injection pump pivot spring and reconnect all hoses that were previously detached.
- Refit the flywheel gear unit access cover.
- Refit the RH guard.
- Refit the power steering distributor oil delivery hose to the anti-cavitation expansion box.
- Reconnect the negative battery cable, close the bonnet and refit the exhaust pipe.

BOSCH INJECTION PUMP

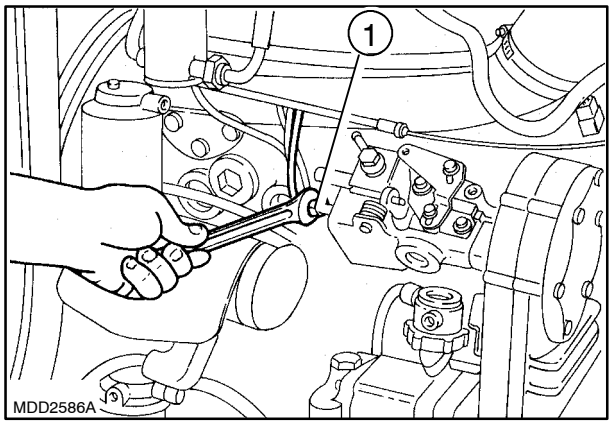
Timing

If the engine does not run evenly, if the timing marks (1) are not visible, or should you be in doubt as to whether the marks are correct, time the injection pump as follows:



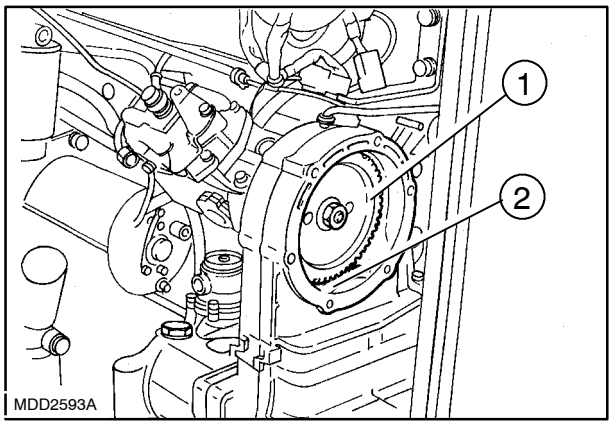
221

19. Unscrew the injection pump/injectors unions (1) and remove the lines.



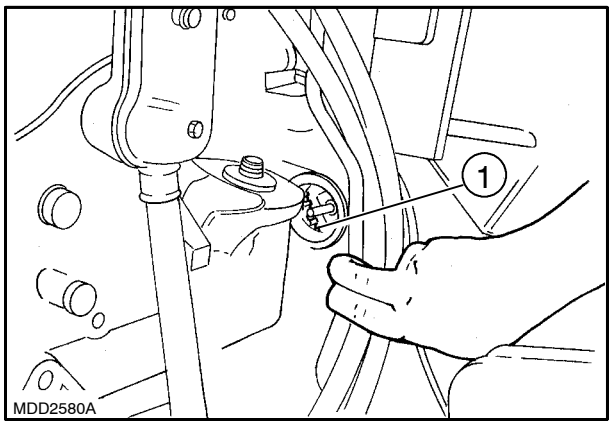
222

20. Remove the front cover.
21. Check that the reference number 4, stamped on the gears (1) and (2), are aligned.



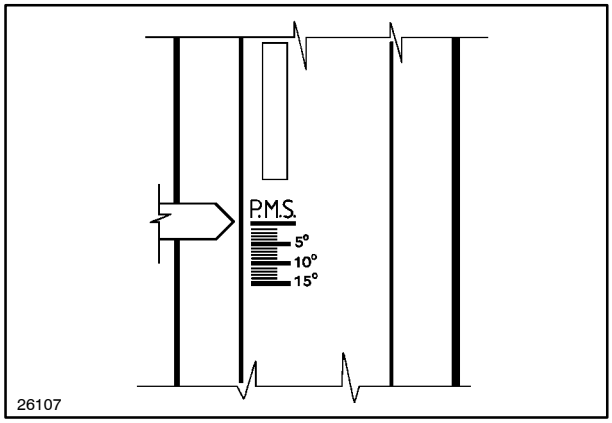
223

22. Remove the flywheel inspection window cover (1).
23. Rotate the crankshaft to bring cylinder no. 1 to TDC (compression stroke).



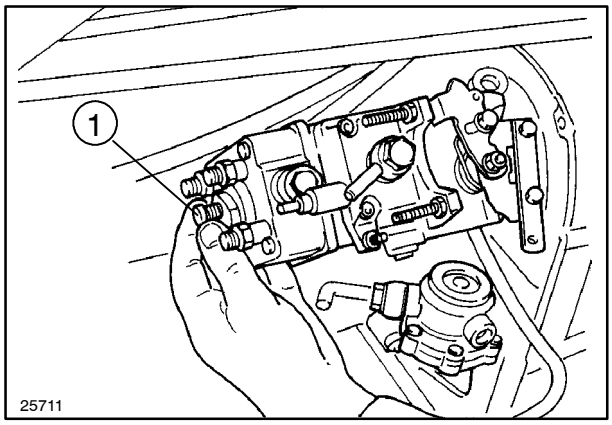
224

24. Check through the inspection window that the pointer is aligned with the T.D.C. reference mark.



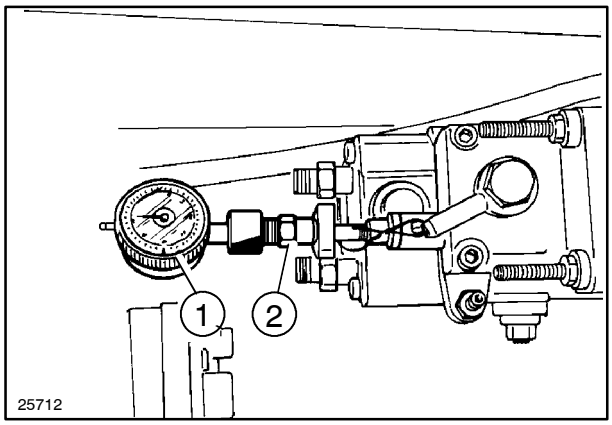
225

25. With the injection pump in position but with the mounting bolts loose, remove the plug (1) on the pump housing.
26. Fit the dial gauge **380000228** (1) fig. 227 and the associated tool **380000229** (2), pre-loading the shaft by approximately 0.1 in. (2.5 mm).
27. Turn the flywheel slowly backwards, so as to bring the plunger to BDC at the start of the delivery stroke (the point at which the dial gauge needle stops falling).



226

28. Zero-set the dial gauge and slowly turn the flywheel clockwise (as viewed from the fan end of the engine) until the pointer lines up with start-of-delivery reference mark (according to the tractor model, see pages 6-8-10-12).
29. Check on the dial gauge that the plunger has completed a stroke of 1 mm up to this point, if not, slacken off the pump mounting bolts.
30. Turn the pump anti-clockwise if the plunger has completed a stroke of less than 0.04 in. (1 mm), and clockwise if the stroke is greater than 0.04 in. (1 mm), repeating the test until the correct stroke is obtained.
31. Having obtained the correct plunger stroke, fix the pump in position by tightening the mounting nuts (1 fig. 217) to the torque specified on page 22.
32. Stamp pump timing marks (1, as shown in fig. 221) on the guard, pump and spacer.
33. Remove the dial gauge **380000228** (1) and the associated tool **380000229** (2) and replace the plug and tighten to a torque of 8 to 10 Nm (0.8 to 1 kgm).
34. Refit other parts in the reverse order to disassembly operations.

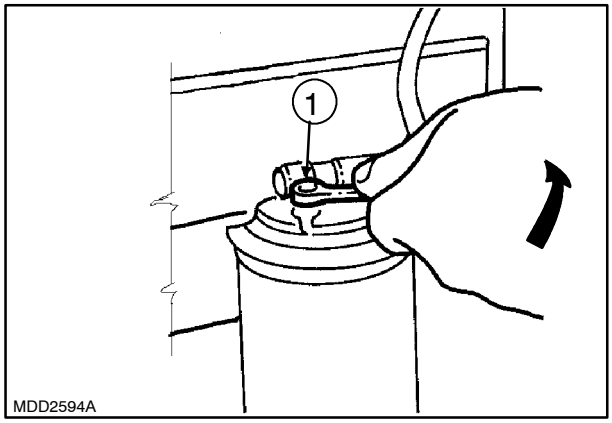


227

BOSCH INJECTION PUMP

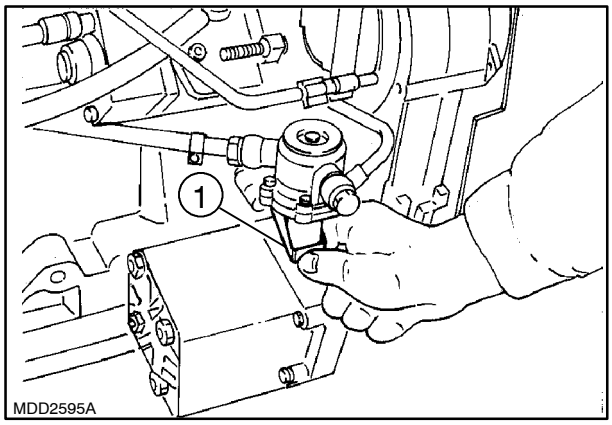
Fuel circuit air bleeding

35. Unscrew the cap (1) on the filter.



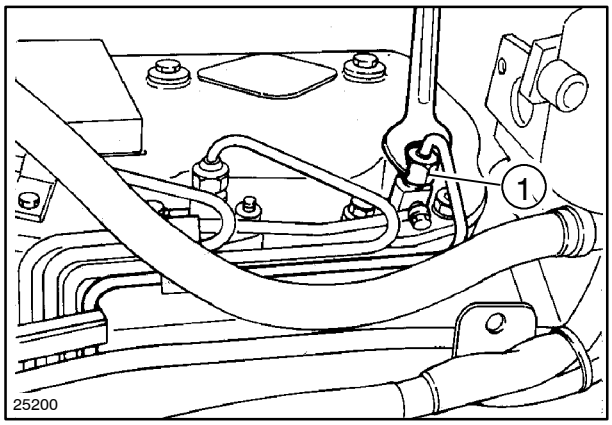
228

36. Operate the fuel pump lever (1) until fuel (without bubbles) comes out of the filter then retighten the cap (1, fig. 228).



229

37. Loosen the injector delivery union (1), start the engine and, after having checked that there are no air bubbles, tighten the union (1).



230

Op. 10 402 10
COOLANT PUMP R.I.

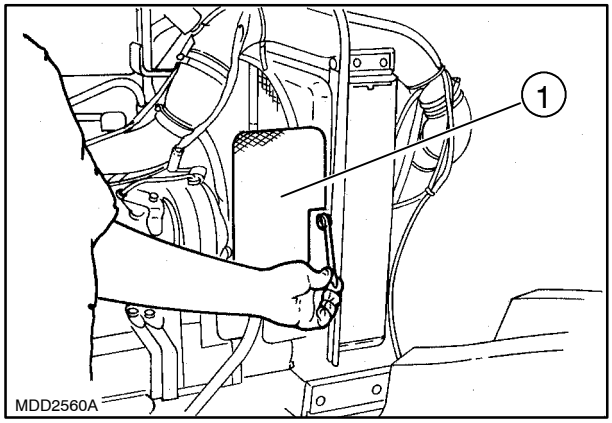
DANGER

Lift and handle all heavy parts using suitable lifting equipment.

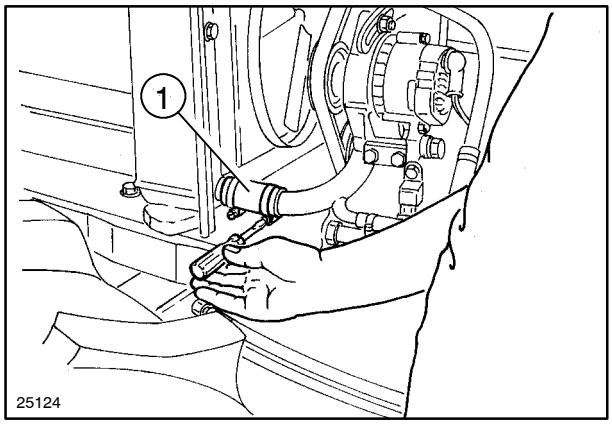
Make sure that assemblies or parts are supported by means of suitable slings and hooks.

Check that no one is in the vicinity of the load to be lifted.

1. Remove the exhaust pipe, open the bonnet, disconnect the battery negative cable and remove the fan LH and RH guards (1).
2. Remove the radiator lower sleeve clamp (1) and drain off the coolant by extracting the sleeve.

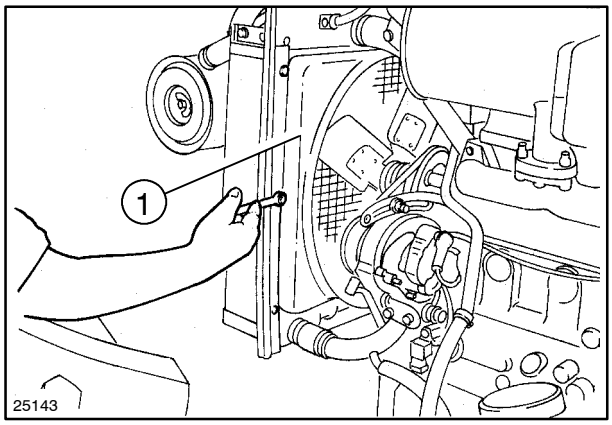


231



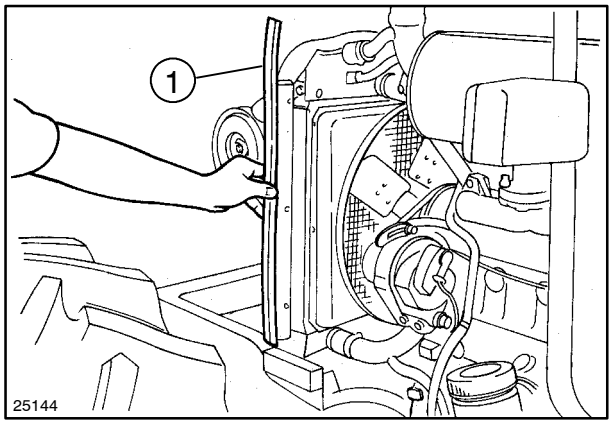
232

3. Unscrew the air conveyor (1) retaining bolts.



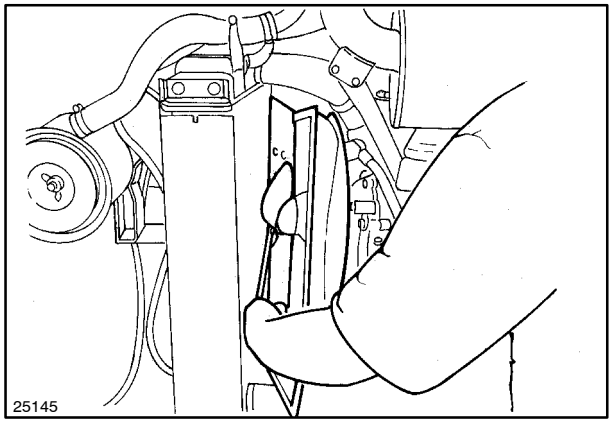
233

4. Remove the two strips (1) located at the sides of the radiator.



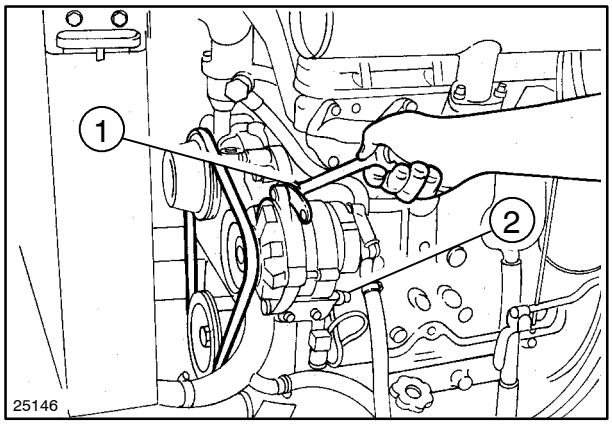
234

5. Move the conveyor towards the engine.
6. Unscrew the three fan/coolant pump shaft retaining bolts and remove the fan and conveyor.



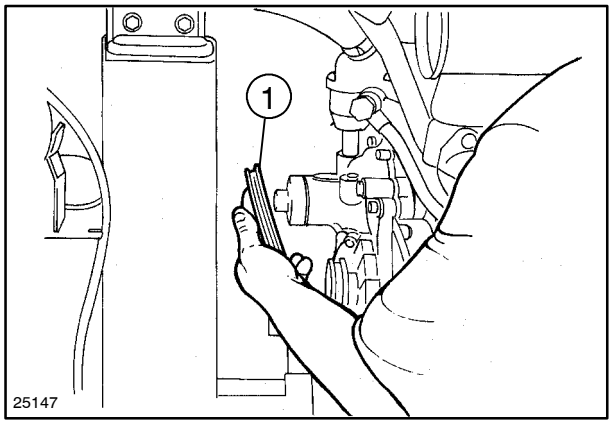
235

7. Loosen the alternator pivot bolt (2) on the relative support.
8. Loosen the belt tension bolt (1) and remove the belt.



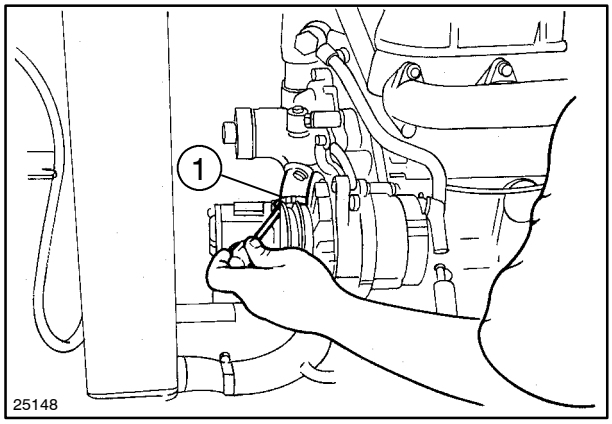
236

9. Remove the coolant pump pulley (1).



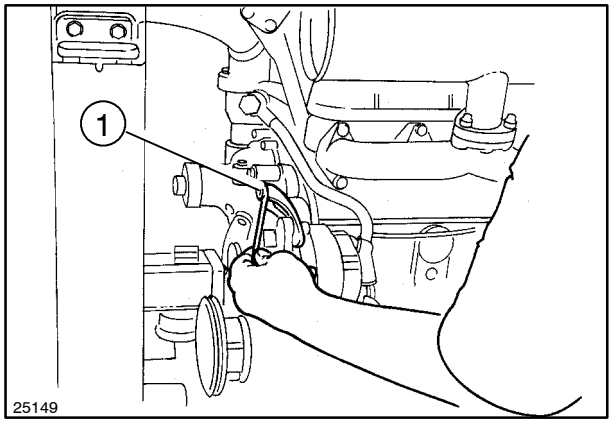
237

10. Loosen the clamp (1) and extract the sleeve from the coolant pump.



238

11. Unscrew the retaining nut (1, fig. 239) from the slotted bracket and shift the alternator outside.
12. Remove the union (1, fig. 240) to access the pump retaining bolt (2).
13. Unscrew the four bolts (1, fig. 241) that secure the coolant pump to the associated support.
14. Remove the coolant pump unit (1, fig. 242) after extracting it from the connecting line with the thermostatic valve.
15. To install the coolant pump, proceed as follows.

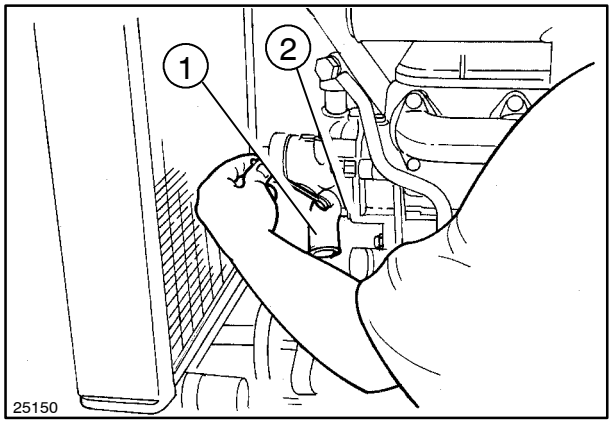


239

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Respect the tightening torques prescribed on page 22.
- Refit the coolant pump on the spacer. Take care not to damage the seals on the vertical hose that connects the coolant pump with the thermostatic valve unit tank.



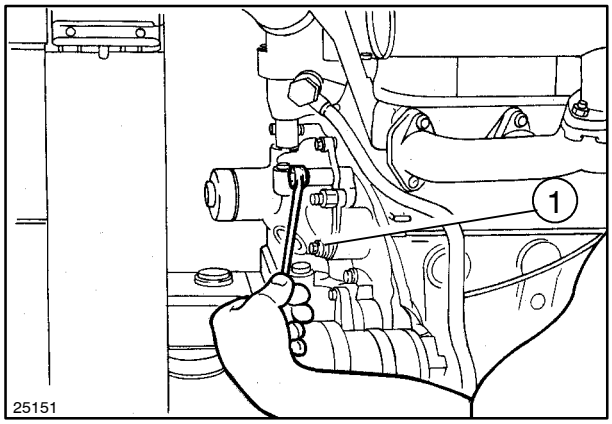
240

- Refit the union pipe on the coolant pump securing in position with the two bolts.
- Refit the pulley with fan.

  Fit the plastic conveyor and the two vertical strips at the same time.

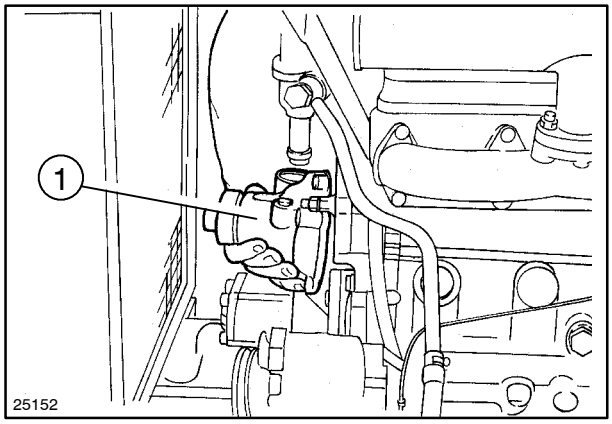
  Fit the alternator and belt tension adjustment slotted support bracket.

  Secure the alternator with the bolt on the lower part.
- Refit the hose on the coolant pump union to the union on the lower part of the radiator.



241

- Refit the RH lateral guard.
- Refit the LH side guard.
- Refill the engine cooling circuit through the radiator filler cap.
- connect the negative battery cable and refit the exhaust pipe.



242

Op. 10 402 28
COOLANT PUMP D.A.

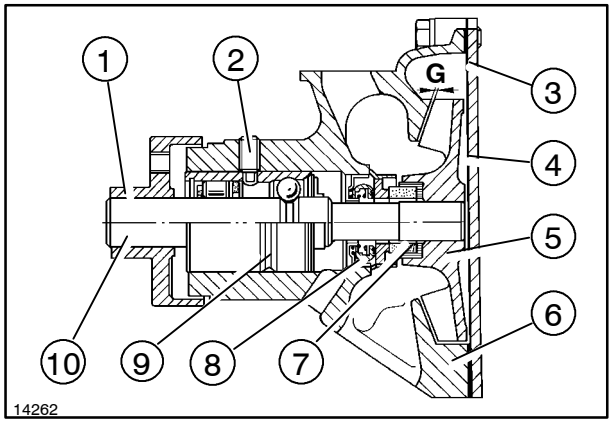
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

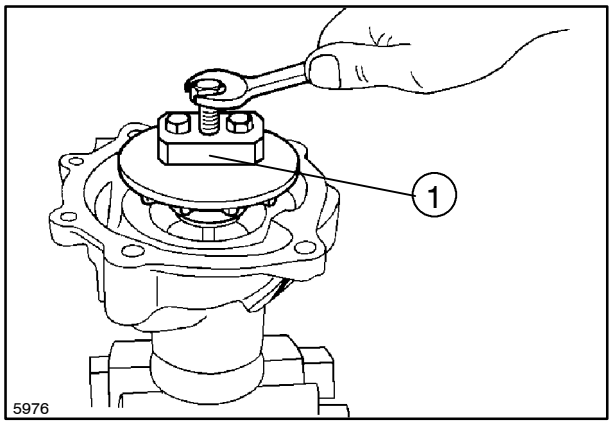
NOTE: *The bearing (9) forms a single piece with the control shaft (10); it is a sealed unit and requires no lubrication during running.*

Overhaul the pump as follows:

1. Remove the cover (4, fig. 243) and the screw (2) retaining the shaft (10) and bearing (9).
2. Gently tap the end of the shaft (10, fig. 243) on the rotor side (5) to break the film of oxide between the shaft and the rotor; fit extractor **380000233** (1, fig. 244) and remove the rotor.
3. Remove the front seal bushing (7, fig. 243).
4. Using a suitable punch, extract from the pump casing (6, fig. 243) the shaft (10) with the bearing (9) and fan hub (1).



243



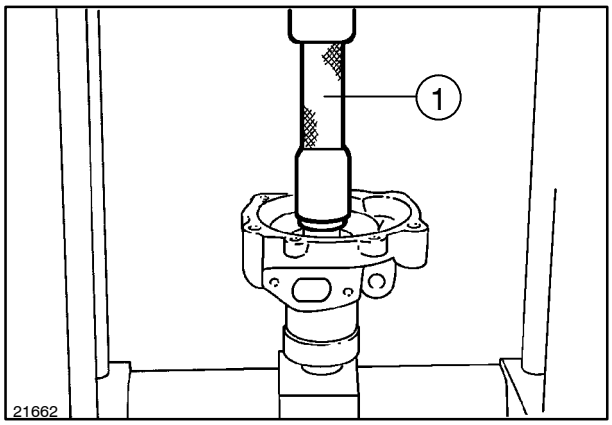
244

NOTE: *Only remove the seal (8, fig. 243) when it needs to be replaced.*

Check components for wear, replacing parts that are in poor condition.

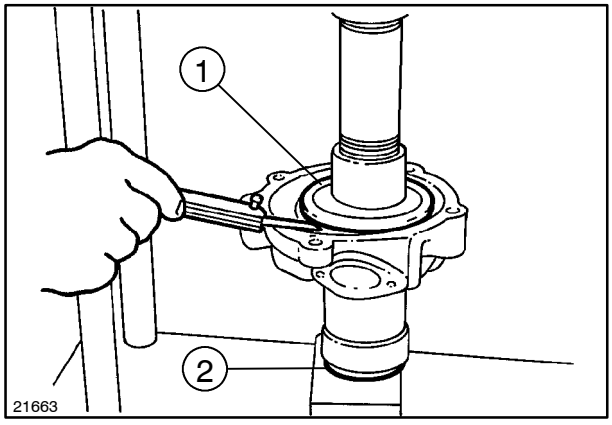
5. Refit the parts, proceeding as follows:

- Fit the shaft (10, fig. 243) with the bearing (9) and hub (1) on the pump casing (6) and secure with the retaining screw (2), smeared with LOCTITE 242.



245

- If replacing, insert the seal (8, fig. 243) in its seat, using the press **380000247** (1, fig. 245).
- Heat the rotor (1) in an air oven, to reach a temperature difference of 266 to 302 °F (130 to 150 °C) in relation to the shaft (2).
- Place the rotor (1) on the shaft (2), easing it onto the end so as not to damage the bearing, until obtaining an operating clearance of G = 0.02 to 0.03 in. (0.5 to 0.7 mm) (see fig. 243).
- Fit the seal (3, fig. 243) and the cover (4) securing in position with the relevant screws.



246

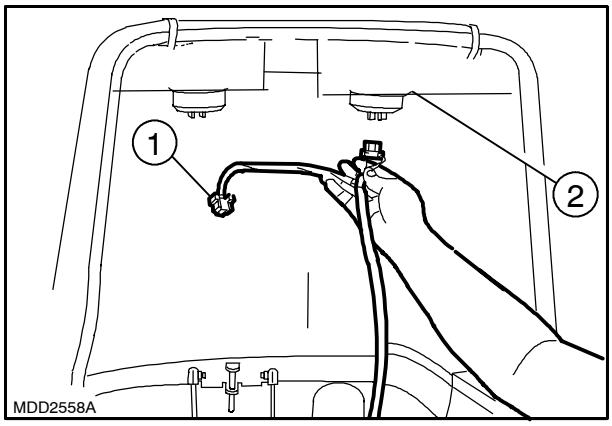
Op. 10 402 30
THERMOSTAT VALVE R.I.

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

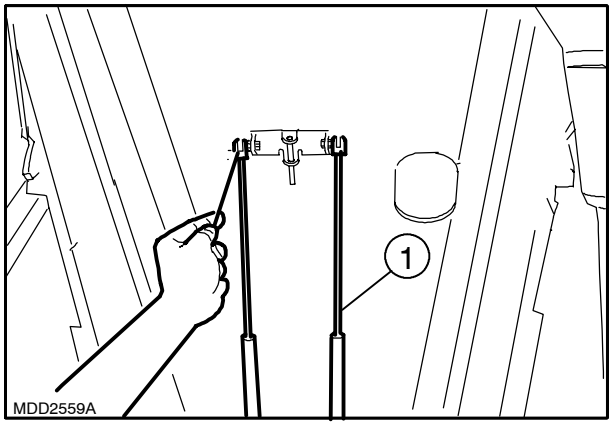
1. Disconnect the battery negative cable.

2. Remove the exhaust pipe, raise the bonnet and disconnect the front headlight (2) connections (1).



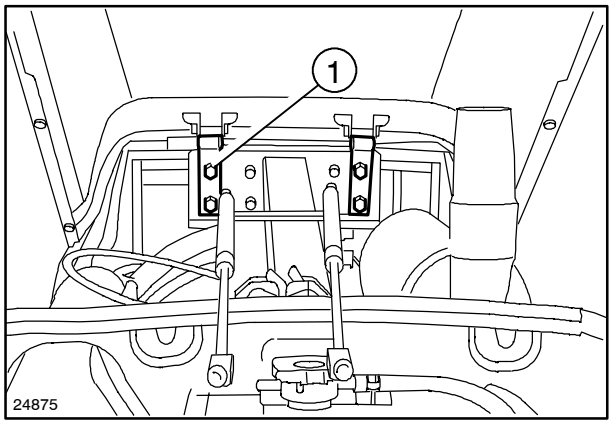
247

3. Remove the gas spring (1) from the bonnet.



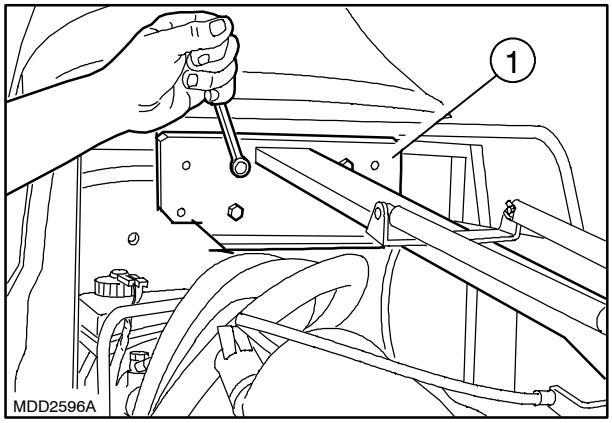
248

4. Unscrew the four bolts (1) retaining the hinge bracket and remove the bonnet.



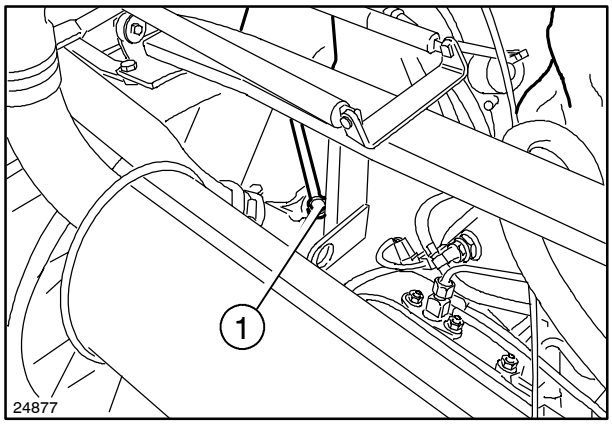
249

5. Remove the bonnet support rear bracket (1) retaining bolts.



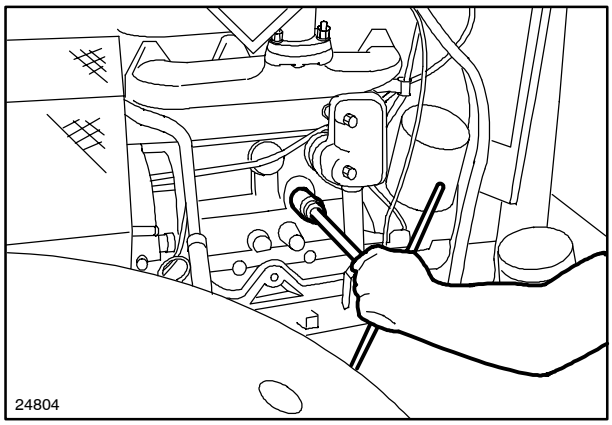
250

6. Remove the bonnet support front bracket retaining bolts (1).



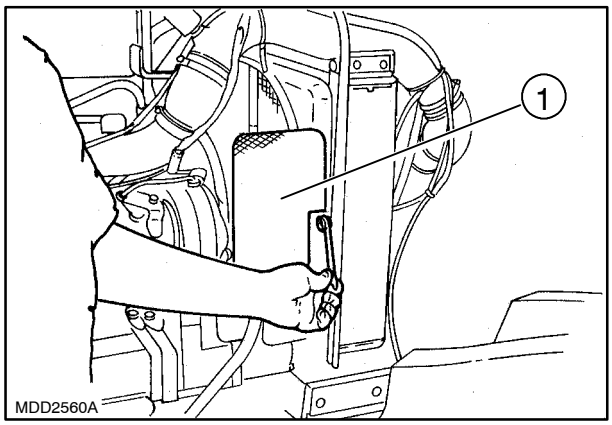
251

7. Drain off the coolant from the plug on the engine block.



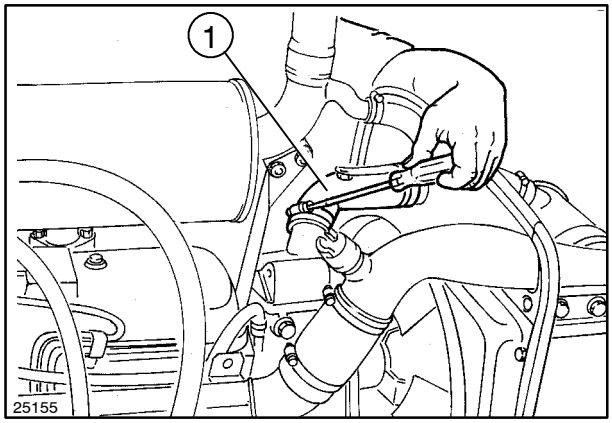
252

8. Remove the right-hand side fan guard (1).



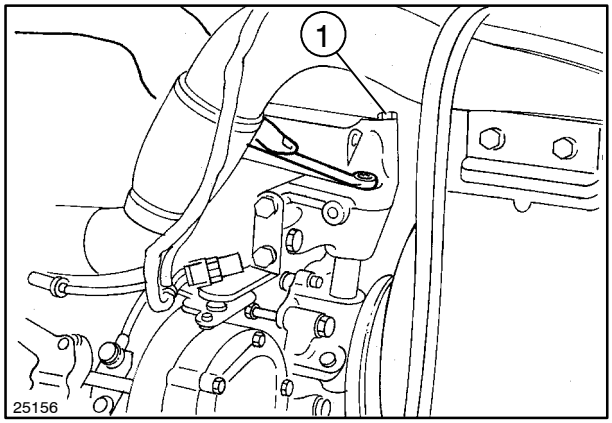
253

9. Remove the clamp and extract the sleeve (1) connecting the radiator and thermostat valve.



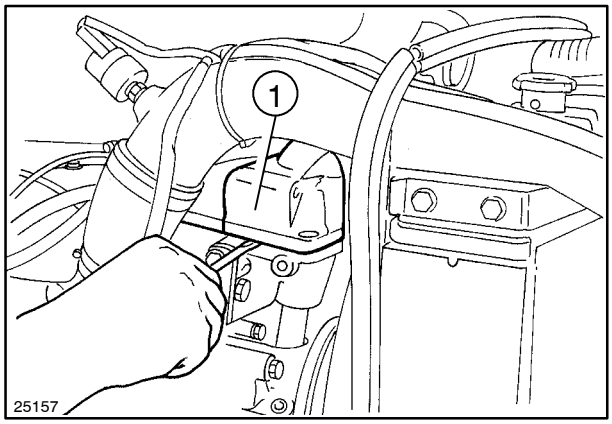
254

10. Remove the thermostat valve cover retaining bolts (1).



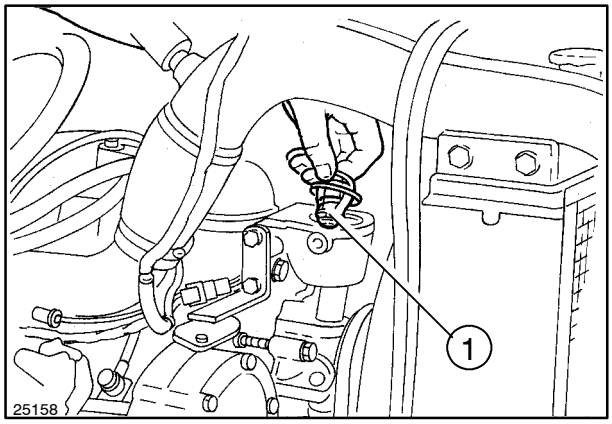
255

11. Use a screwdriver to separate the cover (1) from the casing and remove the cover.



256

12. Remove the thermostat valve (1).



257

13. To refit the thermostat valve, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Respect the tightening torques prescribed on page 22.

- Refit the thermostatic valve, after positioning the seal.
  Fit the upper part to the lower part.

- Insert the rubber hose in the thermostatic valve assembly union and secure the hose with the adjustable metal clamp.

- Refit the bonnet support bracket.

- Refit the right-hand wire mesh guard.

- Refit the bonnet.

- Fill up the cooling circuit.
  Top up where necessary.

- Reconnect the battery negative lead.

- Close the hood and refit the exhaust pipe.

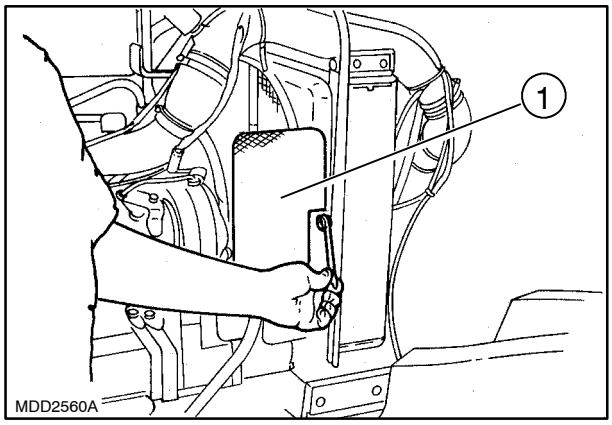
Op. 10 406 10
RADIATOR R.I.

DANGER

Lift and handle all heavy parts using suitable lifting equipment.

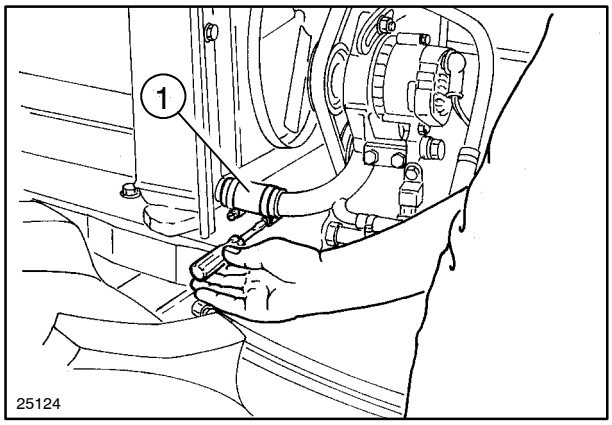
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

1. Remove the exhaust pipe and open the bonnet.
2. Disconnect the battery negative cable.
3. Remove the RH and LH fan guards (1).



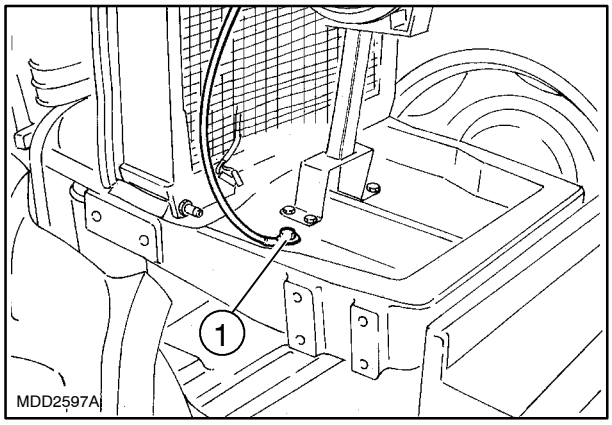
258

4. Remove the radiator lower sleeve clamp (1) and drain off the coolant by extracting the sleeve.



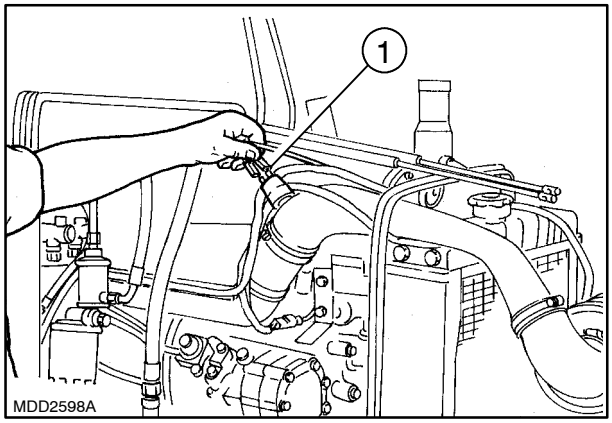
259

5. Remove the ground lead bolt (1) on the front axle support.
6. Disconnect the horn wires.



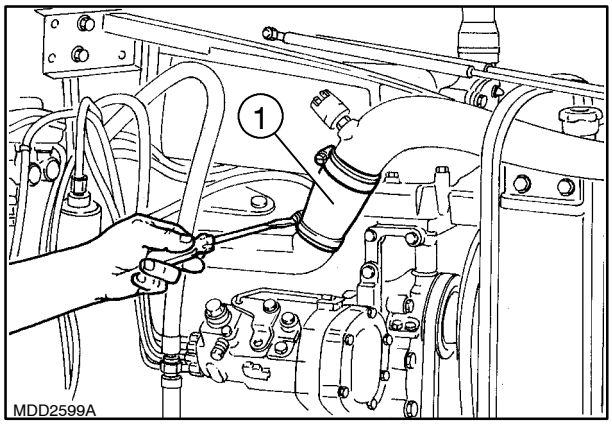
260

7. Disconnect the air filter clogged sensor wires (1).



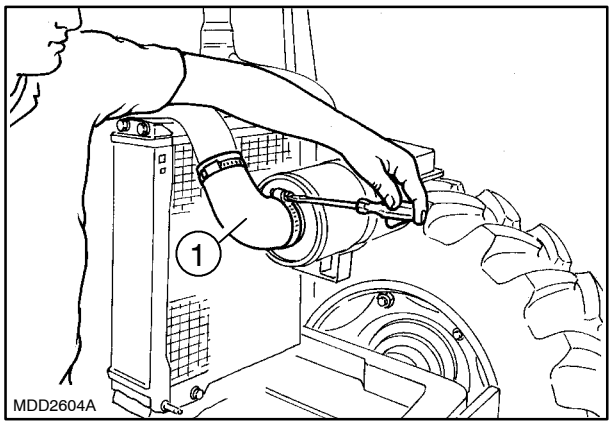
261

8. Remove the clamp securing the sleeve (1) to the intake manifold.



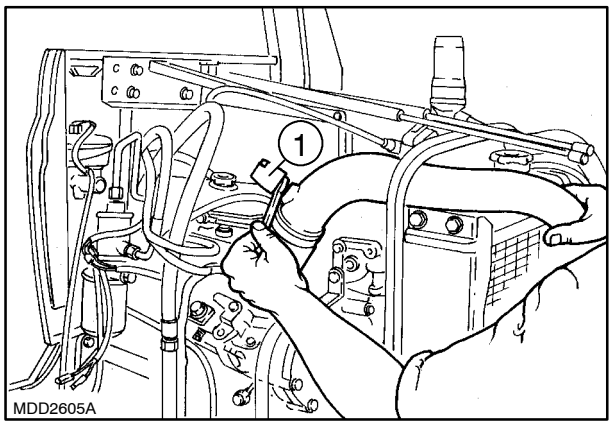
262

9. Remove the clamp securing the sleeve (1) to the air filter.



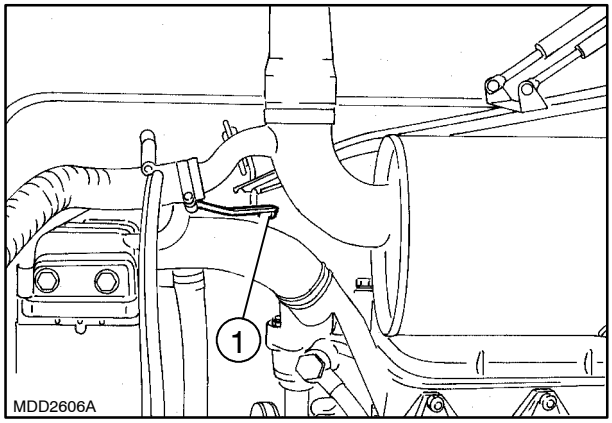
263

10. Disassemble the clogged air filter sensor (1) and remove the pipe.



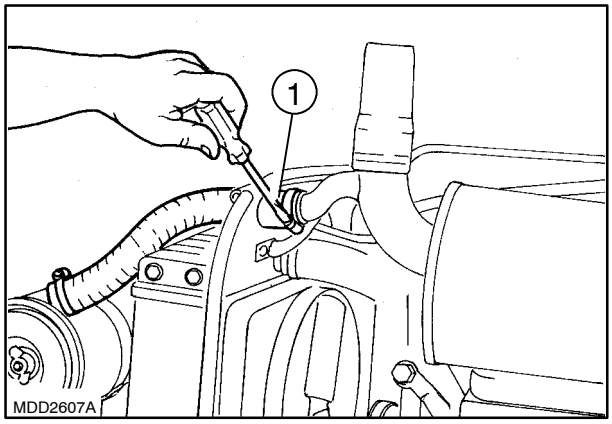
264

11. Remove the bonnet support/radiator bracket (1) connecting bolt.



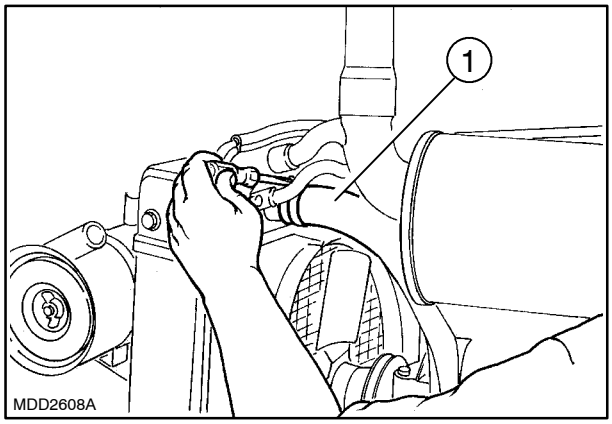
265

12. Remove the clamp and extract the pipe (1) connecting the air filter to the exhaust ejector.



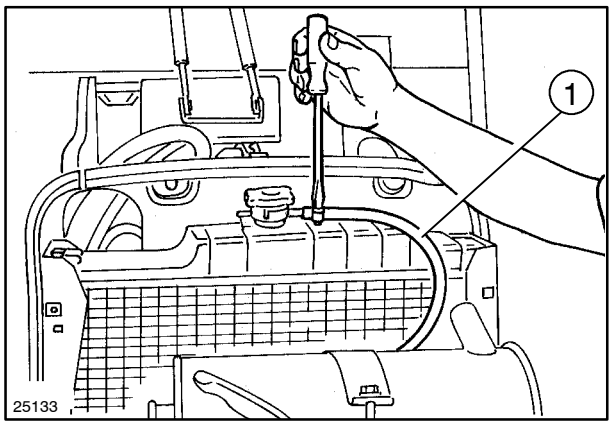
266

13. Remove the clamp and extract the radiator upper sleeve (1).



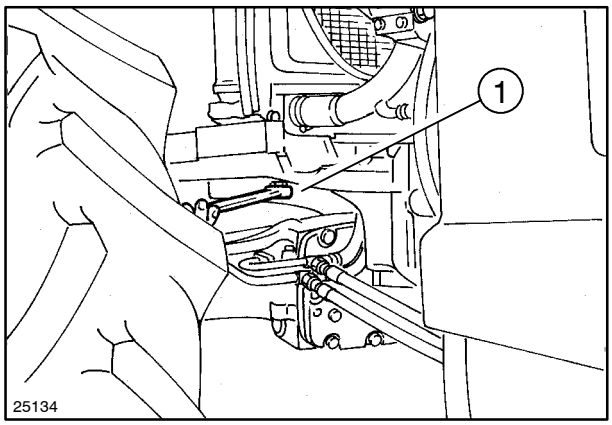
267

14. Remove the clamp and extract the radiator cap flexible hose (1).



268

15. Unscrew the two bolts (1) securing the radiator to the front axle mounting and remove the bolts, spacers and lower rubber blocks.



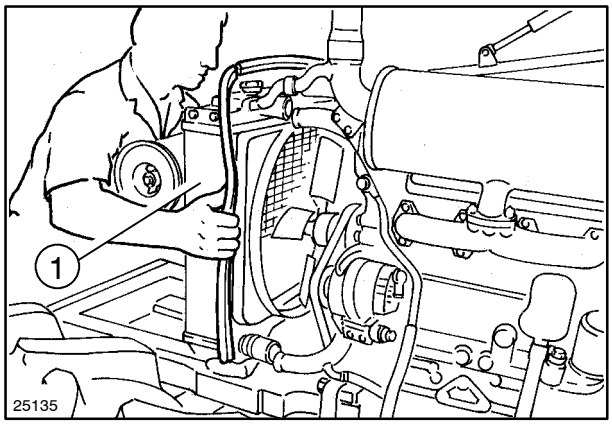
269

16. Remove the radiator (1) and the top rubber blocks.

17. To refit the radiator, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



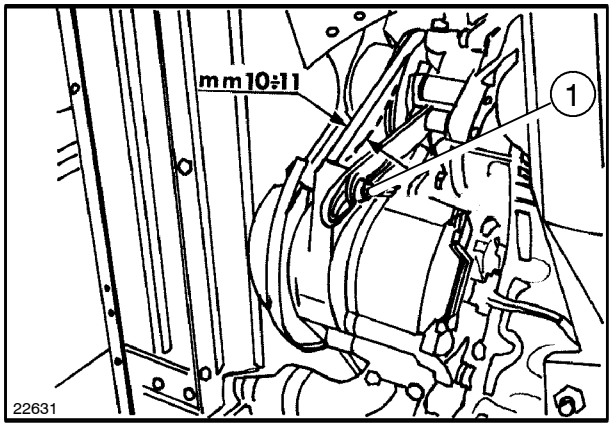
270

- Respect the tightening torques prescribed on page 22.
- Reposition the radiator, securing with two bolts.
- Refit the two sleeves on the coolant pump and thermostatic valve unit. Reconnect the hose on the radiator cap.
- Refit the bonnet support bracket with the bracket fixed on the radiator, tightening the bolt that was previously loosened.
- Reconnect the exhaust ejector hose.
- Refit the connecting pipe between the air filter and the intake manifold. Refit the clogged air filter sensor.
- Reconnect the electrical connections: ground, horn, clogged air filter.
- Refit the two lateral guards.
- Fill the radiator with coolant.
- Re-connect the battery negative lead and close the bonnet.

Op. 10 414 10
COOLANT PUMP AND GENERATOR DRIVE BELTS
Adjusting tension
(Disassembly operation 2. to 5.)

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.



271

The fan/coolant pump/alternator drive belt is tensioned correctly when a force of 78 to 98 N (8 to 10 kg), applied at the mid-point of the run between the alternator and coolant pump pulleys, deflects (sags) the belt by 3.937 to 4.33 in. (10 to 11 mm).

1. Check the tension, using the belt tension tester **380000328**, to see if the deflection remains within the aforementioned limits. If not, adjust the tension as follows:

2. Loosen the nut (1) that fastens the alternator to the tensioner.

3. Move the alternator on the tensioner bracket to achieve correct belt tension, then tighten the alternator retaining nut (1) to the torque values noted on page 22.

NOTE: *When fitting a new belt, check the tension again after one hour of running.*

SECTION 18 - CLUTCH

Chapter 1 - Clutch

CONTENTS

Operation	Description	Page
	Clutches. General specifications	2
	Tightening Torques	3
	Tools	3
	Cross-sectional views	4
	Fault diagnosis	5
	Checks, dimensions and repairs	6
18 100 40	Main transmission clutch release - Adjustment	8
18 110 10	Clutch R.I.	9
18 110 30	Dual Clutch 12"/12" - Test bench overhaul and adjustment	21

LUK 12"/12" CLUTCH - GENERAL SPECIFICATIONS (MODELS TL70, TL80, TL90, see fig. 2)

Type		single disk, dry plate dual clutch unit
Mechanical		operation: pedal operated main transmission clutch; hand lever operated PTO clutch
Engagement and release mechanism		Single Belleville spring disc
Driven plates lining material		
- main transmission clutch (for model TL70):		organic agglomerate
- main transmission clutch (for models TL80 and TL90):		cerametallic pads
- PTO clutch (for all models noted above)		organic agglomerate
Driven plate thickness:		
- main transmission clutch (organic agglomerate)	in. (mm)	0.3818 to 0.4055 (9.7 to 10.3)
- main transmission clutch (cerametallic)	in. (mm)	0.3779 to 0.4094 (9.6 to 10.4)
- PTO clutch	in. (mm)	0.2874 to 0.3110 (7.3 to 7.9)
- wear limit	in. (mm)	see page 6
Clearance between main transmission clutch release sleeve and housing	in. (mm)	0.0023 to 0.0070 (0.060 to 0.180)
Clearance between PTO clutch release sleeve and housing	in. (mm)	0.0023 to 0.0070 (0.060 to 0.180)
Release lever coplanarity adjustment		see page 25
Clutch control adjustment		see page 8

LUK 12" CLUTCH - GENERAL SPECIFICATIONS (MODEL TL100, see fig. 1)

Type		single dry plate clutch
Mechanical		operation with pedal
Engagement and release mechanism		Belleville spring disk
Driven plate lining material for main transmission clutch		cerametallic pads
Driven plate thickness for main transmission clutch (1, fig. 1)	in. (mm)	0.3779 to 0.4094 (9.6 to 10.4)
- Driven plate wear limit	"	see page 25
Clearance between clutch release sliding sleeve and support	in. (mm)	0.0023 to 0.0070 (0.060 to 0.180)
Clutch control adjustment		see page 8

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Release command fork securing bolt (7, fig. 2)	M 16 x 1.5	157	16
12”/12” clutch/flywheel retaining bolts (2, fig. 47)	M 10 x 1.25	59	6
Clutch housing/engine retaining nuts (3, fig. 2)	M 12 x 1.25	98	10
Nut for sleeve cover fixing stud (6, fig. 2)	M 8 x 1.25	17	1.7

TOOLS

Warning - The operations described in this section can only be carried out the with **ESSENTIAL** tools indicated by an **(X)**.
To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

380000236 Tractor disassembly stand.

380000292 Pin for centring and adjustment of 12” and 12”/12” clutches.

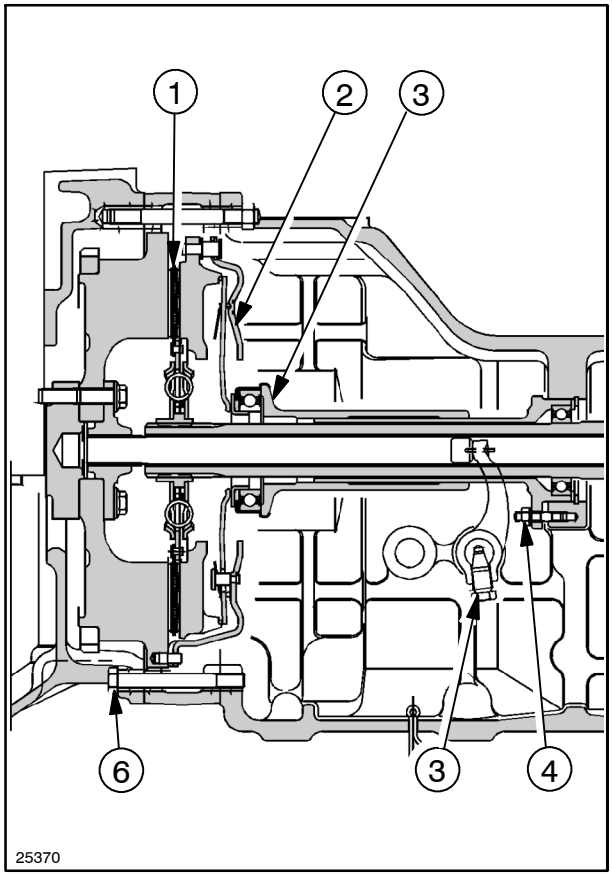
380000293 Clutch adjustment gauge (with **380000292**).

380000256 Set of wrenches for adjustment of levers in 12”/12” LUK clutches.

Longitudinal section of 12" LUK clutch

1. Main transmission clutch plate.
2. Diaphragm spring.
3. Release sleeves, complete with thrust bearing.
4. Nuts for sleeve cover studs.
5. Fork lever retaining bolt.
6. Bolts and nuts securing clutch casing to the engine.

NOTE: *When refitting the clutch, check that the clutch disks are positioned as in the drawing.*



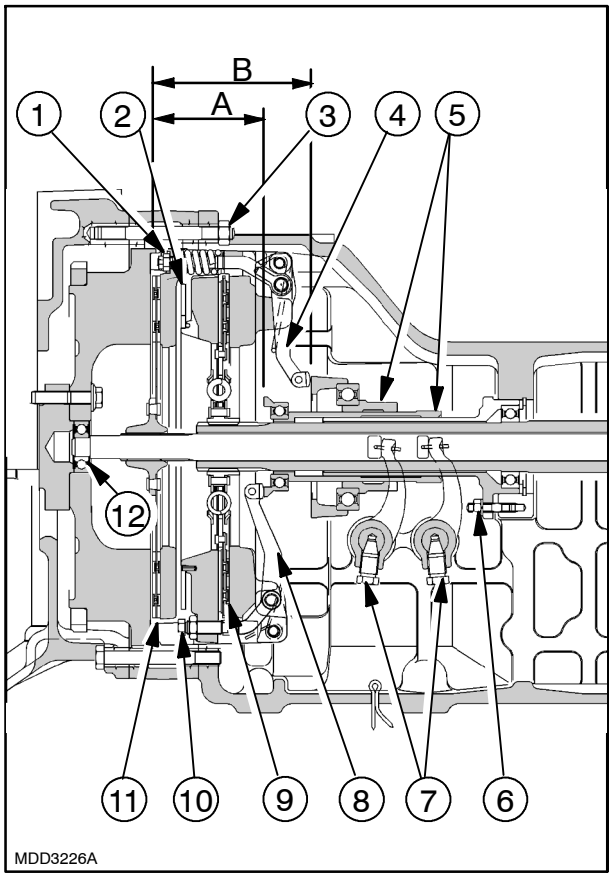
1

Longitudinal section of 12"/12" LUK clutch

1. PTO clutch release lever adjuster.
2. Belleville Spring.
3. Bolts and nuts securing clutch casing to the engine.
4. Power take-off clutch disengagement levers.
5. Release sleeves for main transmission and PTO clutch, complete with thrust bearings.
6. Nuts for sleeve cover studs.
7. Fork lever retaining bolt.
8. Main transmission clutch release lever.
9. Main transmission clutch plate.
10. Main transmission clutch release lever adjuster.
11. Power take-off clutch disk.
12. Bearing on flywheel.

A. 4.0551 in. (103 mm). Nominal distance of release levers (8) from clutch contact surface on flywheel.

B. 5.7086 in. (145 mm). Nominal distance of release levers (4) from clutch contact surface on flywheel.



2

CLUTCH TROUBLESHOOTING

Problems	Possible Causes	Solutions
Clutch slips	1. Worn disks (11 and 9, fig. 2) on pressure plates and flywheel (1-2-3-4, page 6).	Check and compare the data given on the pages indicated, replace any parts which are worn up to or over the limit and adjust levers and clutch control linkage.
	2. Belleville spring disk (2, fig. 2) stretched or damaged.	Replace the Belleville spring disk.
	3. Oil or grease contaminating the disk friction material (11 and 9).	Replace the disks, identify and eliminate the source of lubricant inside the clutch housing and thoroughly clean the friction surfaces.
Fierce clutch	1. Partial seizure of the external control linkage.	Check rod pivots and lubricate.
	2. Clutch disk (9) deformed.	Replace the disk and adjust the clutch control lever.
	3. Clutch disk (9) with spring drive damaged or with hub rivets loose.	Replace disk.
	4. Oil or grease contaminating the friction lining of disks (11 and 9).	Replace the disks, identify and eliminate the source of lubricant inside the clutch housing and thoroughly clean the friction surfaces.
Clutch sticks and drags	1. Clutch disks (11 and 9) deformed.	Replace and adjust disks.
	2. Seizure of external control linkage.	Check, replace faulty parts and lubricate.
	3. Controls incorrectly adjusted.	Adjust the controls (see page 8).
Clutch noisy when engaged and/or disengaged	1. Thrust bearing worn.	Replace Bearing
	2. Clutch disk (9) with spring drive faulty.	Replace disk.
Clutch pedal too stiff	1. Partial seizure of the external control linkage.	Check rod pivots and lubricate.
	2. Partial seizure of pedal pivot.	Check pivot and lubricate.

CHECKS, MEASUREMENTS AND REPAIRS - 12"/12" DUAL CLUTCH

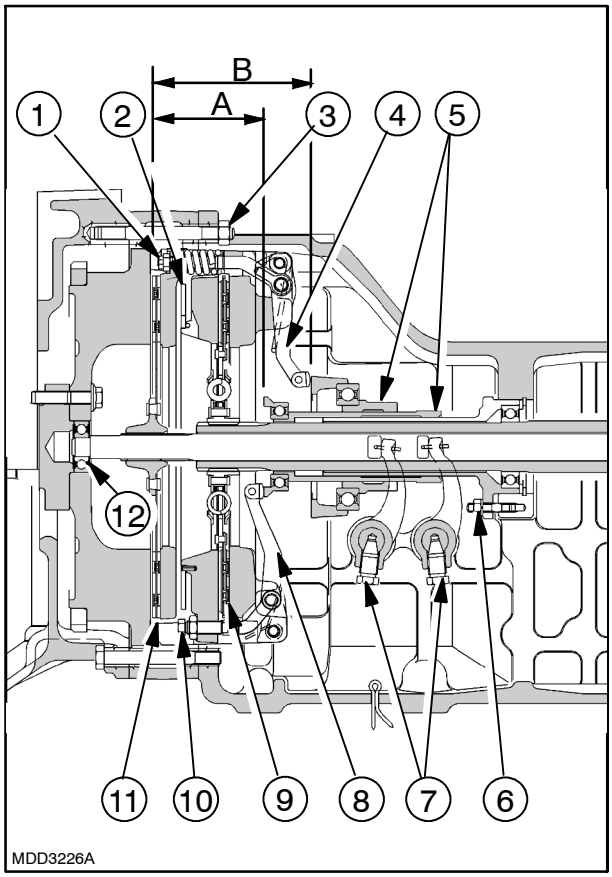
CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Check all parts carefully.

- Check the degree of wear on the PTO (11, fig. 3) and main transmission (9) clutch disks, replacing them if the linings have worn down (or are nearly worn down) to the rivet heads.
- Replace the disk when the oil has soaked into the organic agglomerate surfaces.
- Check the friction surface conditions of the pressure plates (2 and 3 fig. 4) and the clutch cover (4).

  Generally, by means of turning, up to 0.0295 in. (0.75 mm) of material can be removed from the cast iron friction surfaces of the clutch cover (4) and pressure plate rings (2 and 3).

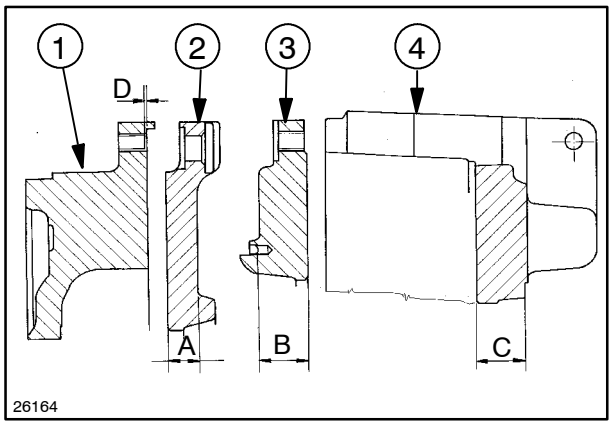


3

Minimum permissible dimensions after refacing of parts subject to wear in the 12"/12" dual clutch are:

1. Flywheel.
2. PTO clutch pressure plate rings.
3. Main transmission clutch pressure plate ring.
4. Clutch cover.

A. ≥ 0.5216 in. (≥ 13.25 mm).
B. ≥ 1.1358 in. (≥ 28.85 mm).
C. ≥ 0.8641 in. (≥ 21.95 mm).
D. = (14-A) + 0.0196 in. (0.5 mm).



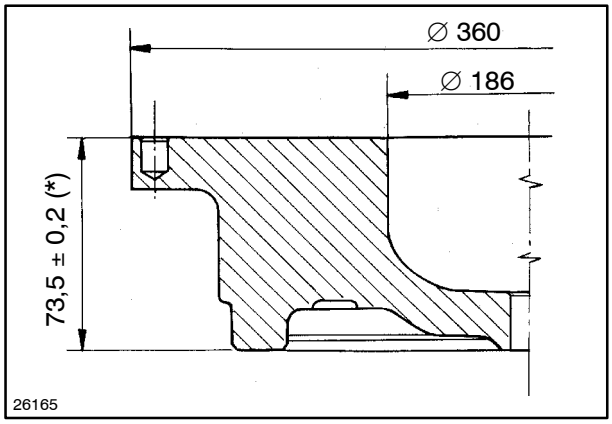
4

When parts (1), (2), (3) and (4, fig. 4) are to be repaired by removing material, proceed as follows:

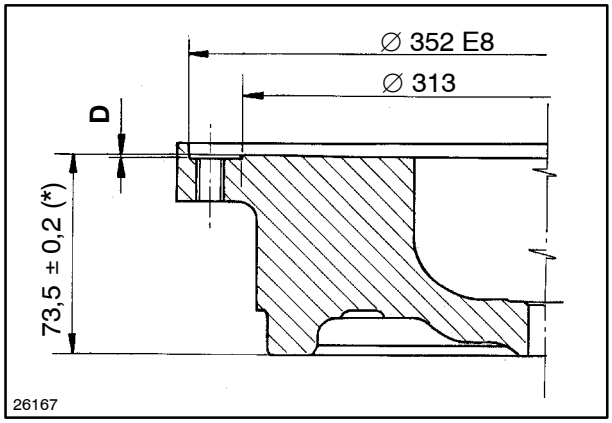
- If it is necessary to reface the friction surface on the flywheel (1, fig. 4), bear in mind that the maximum permissible grinding in relation to the nominal dimension* (see figs. 5 and 6) is 0.0393 in. (1 mm).

- For flywheels of 12"/12" dual clutches (see fig. 6) it is moreover necessary, after refacing the friction surface of the p.t.o. clutch pressure plate, to restore the external surface **D** according to the formula:

  D = (14–A) + 0.0196 in. (0.5 mm).



5



6

NOTE: *Figure 5 corresponds to the flywheel relative to a 12" single disk clutch.*

Figure 6 corresponds to the flywheel relative to a 12"/12" dual disk clutch.

NOTE: *When the main transmission clutch disk starts to slip, after several refacing operations on the parts (3 and 4 fig. 4), the entire clutch assembly will need to be replaced.*

- To reassemble the 12"/12" dual clutch, proceed as described on page 24.

Op. 18 100 40

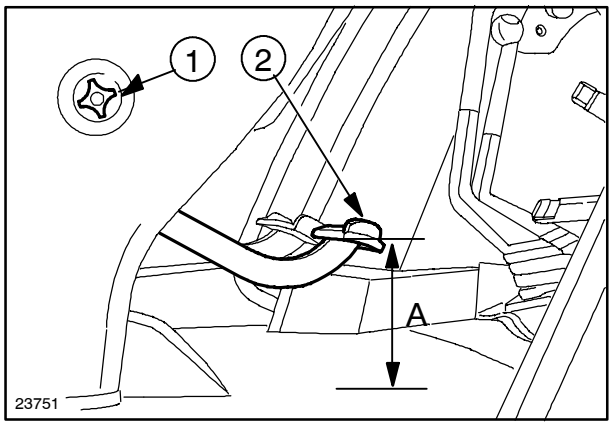
MAIN TRANSMISSION CLUTCH RELEASE

Adjustment

When the position of the clutch pedal (2) is misadjusted or the clutch is overhauled, check that distance “A”, of the main transmission clutch pedal in relation to the flooring is 7.2834 in. (185 mm) for tractors without a cab and 6.3779 in. (162 mm) for tractors with a cab.

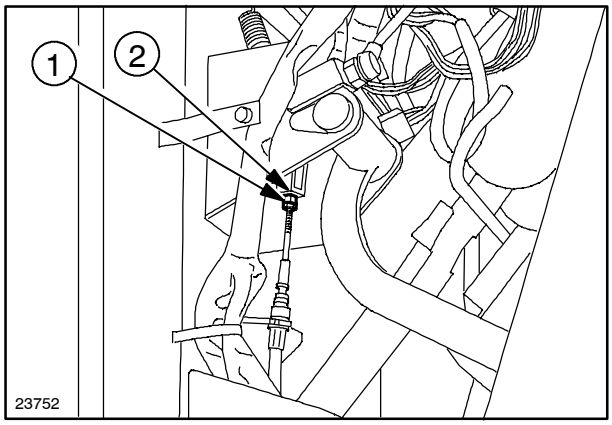
If not, adjust as follows:

1. Remove the knobs (1) and the two lateral panels on the instrument panel to access the adjusting parts.



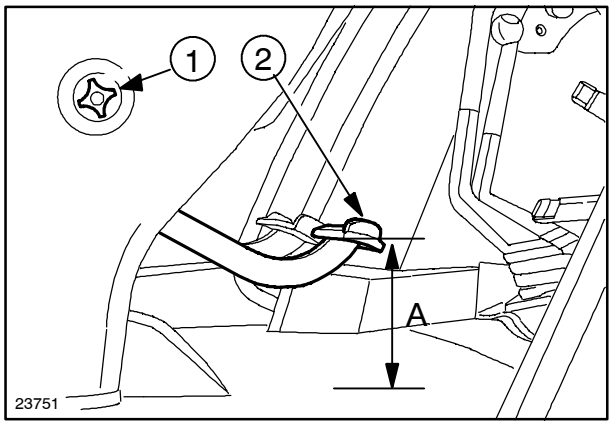
7

2. Unscrew the locknut (1) and turn nut (2) in order to adjust.
3. According to the tractor type, check that distance (A, fig. 7), corresponds to the value noted above, then tighten the locknut (1).



8

4. Push the pedal down a few times, then check that the clutch pedal (2) travel (A) is correct.
5. Refit the two lateral panels on the instrument panel and tighten the knobs (1).



9

NOTE: *As opposed to the main clutch pedal, the PTO clutch lever and tie-rods are self-adjusting.*

Op. 18 110 10
CLUTCH R.I.

To gain access to the clutch the engine must be separated with the axle or front axle from the transmission.

DANGER

Lift and handle all heavy parts using suitable lifting equipment.

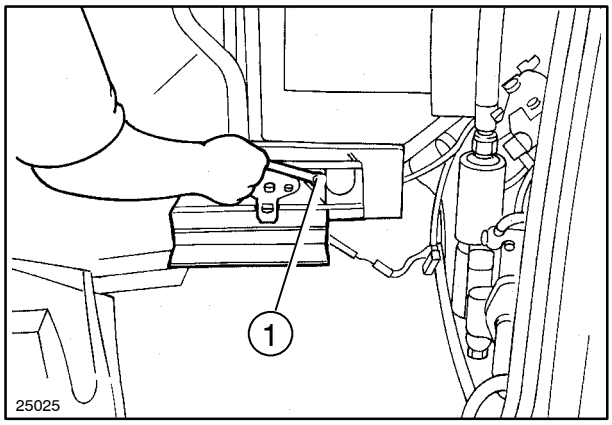
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

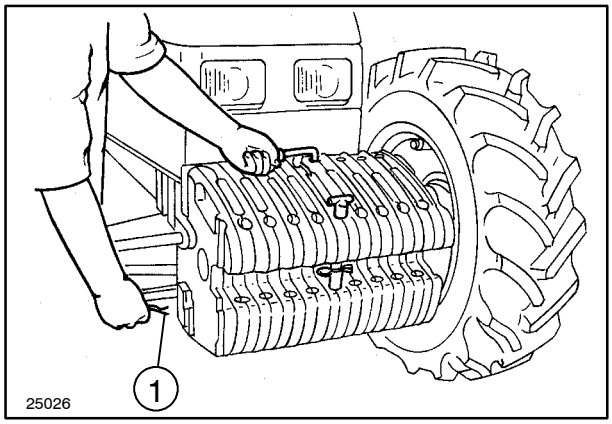
Proceed as follows:

1. Disconnect the battery negative cable.
2. Drain the oil from the rear transmission-gearbox housing.
3. Drain off the coolant from the engine cooling system.
4. Remove the tool box and relative support bracket (1).



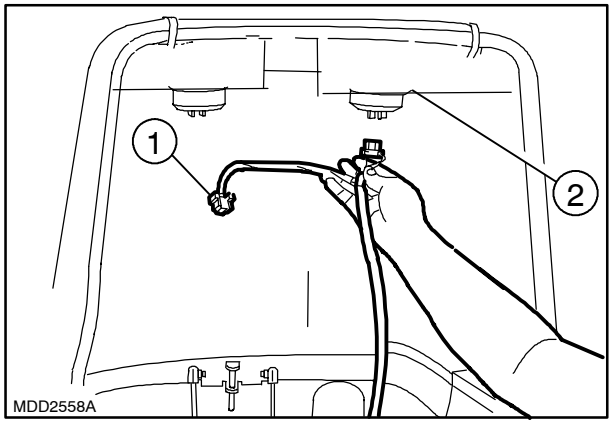
10

5. Remove the split pins, lock pins and front ballast (1).



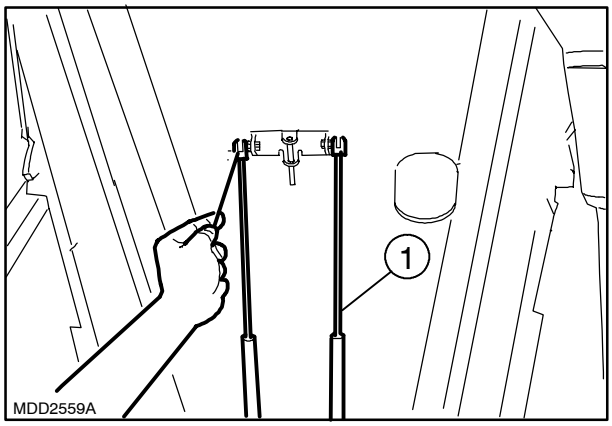
11

6. Remove the exhaust pipe, raise the bonnet and disconnect the front headlight (2) connections (1).



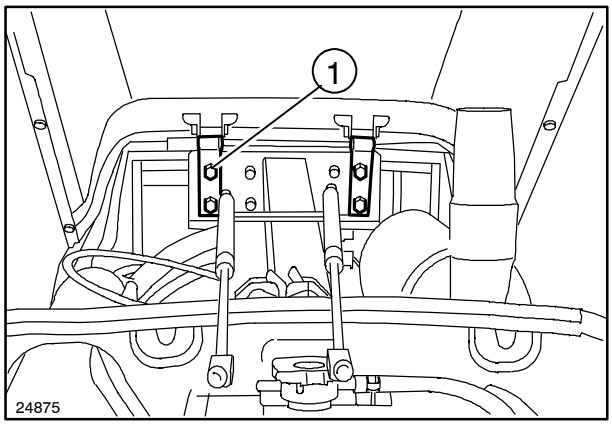
12

7. Remove the gas springs (1) from the bonnet.



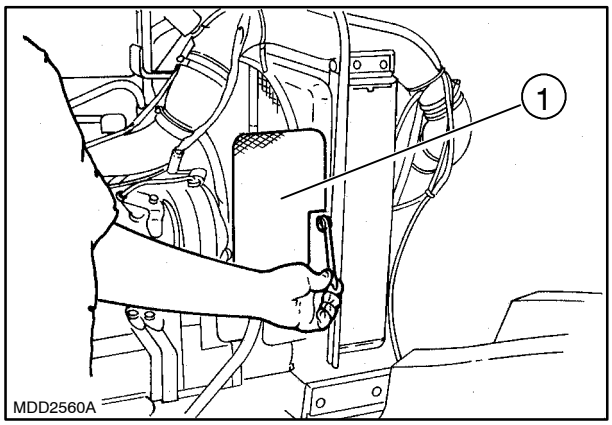
13

8. Unscrew the four pivot bolts (1) and remove the bonnet.



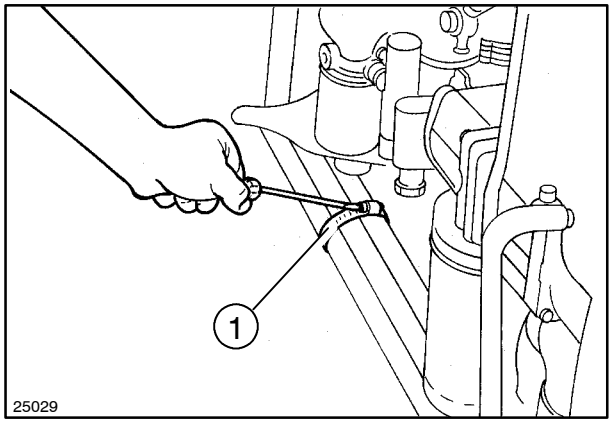
14

9. Remove the right-hand side fan guard (1).



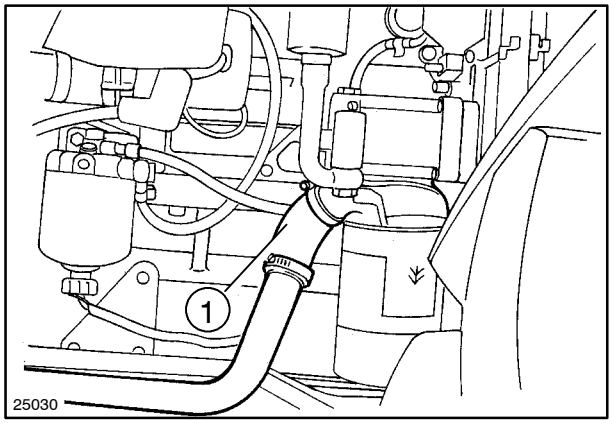
15

10. Remove the metal clamp (1) securing the rigid oil pump and lift oil delivery lines.



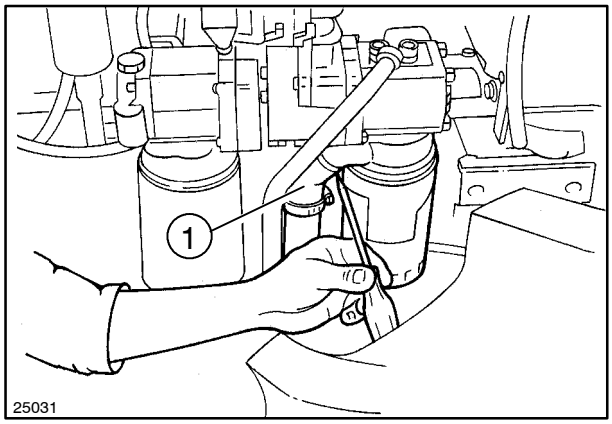
16

11. Extract the sleeve (1) on the services pump priming pipe.



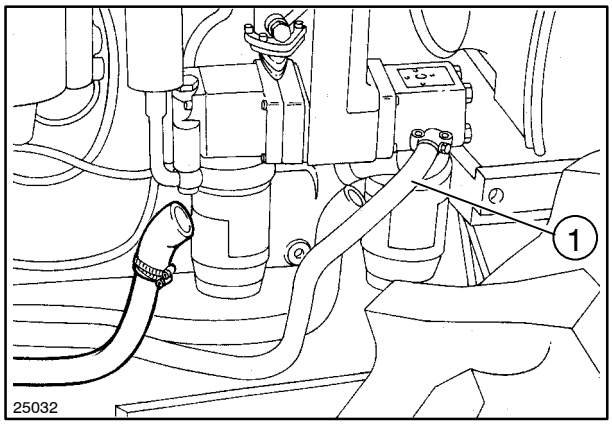
17

12. Extract the sleeve (1) on the lift pump priming pipe.



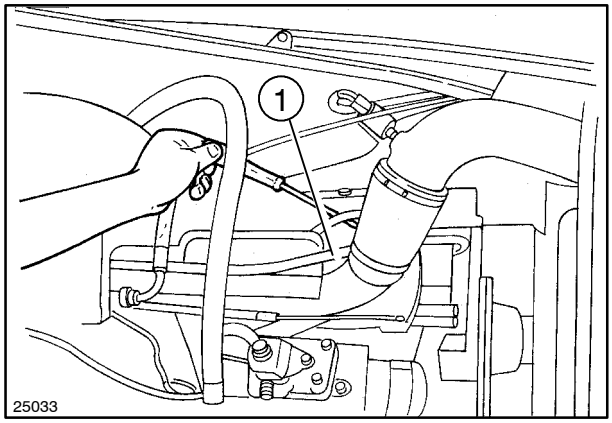
18

13. Detach the lift pump delivery line (1).



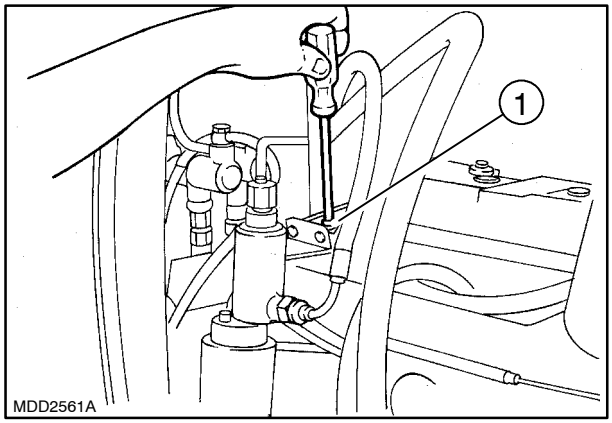
19

14. Detach the fuel line (1) and the glowplug.



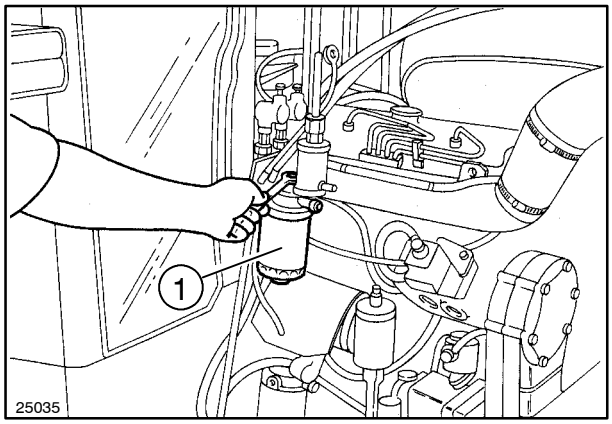
20

15. Detach the injectors fuel recovery line (1) and the tank/decanting filter connecting line.



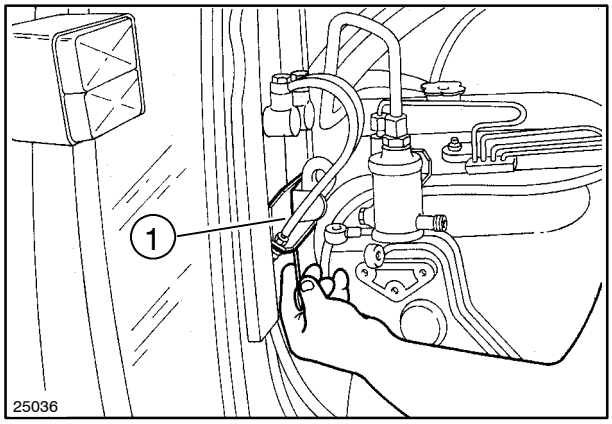
21

16. Detach the support, complete with diesel filter (1).



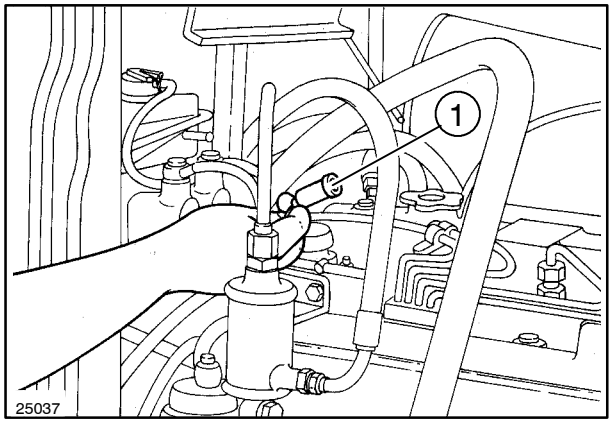
22

17. Remove the brakes flexible piping retaining bracket (1).



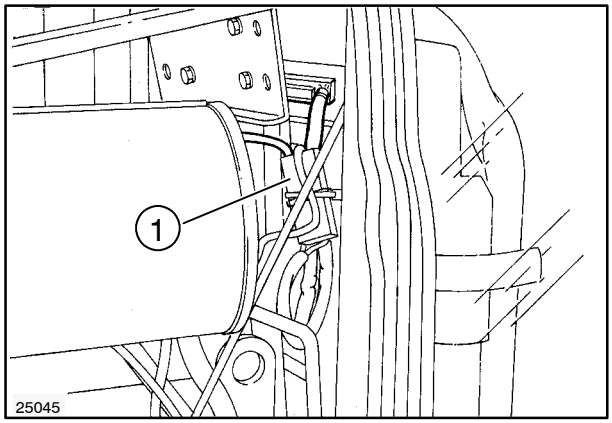
23

18. Disconnect the coolant temperature sensor electrical connection (1).



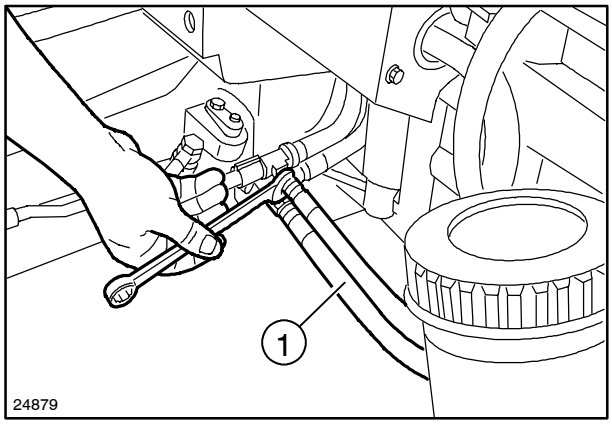
24

19. Disconnect the electrical connections (1) between the cab and the engine.
20. Disconnect the engine oil pressure sensor electrical connection.



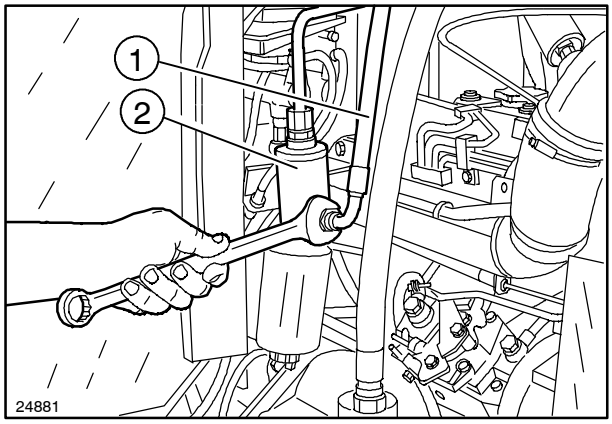
25

21. Detach the rev counter/hourmeter control and remove the clamp from the relative sheath.
22. Disconnect the two power steering oil delivery and return hoses (1).



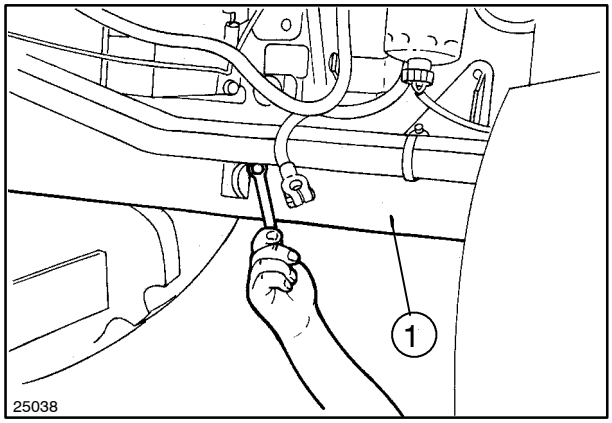
26

23. Disconnect the hose (1) from the anticavitation expansion box (2) located on the power steering unit return line.



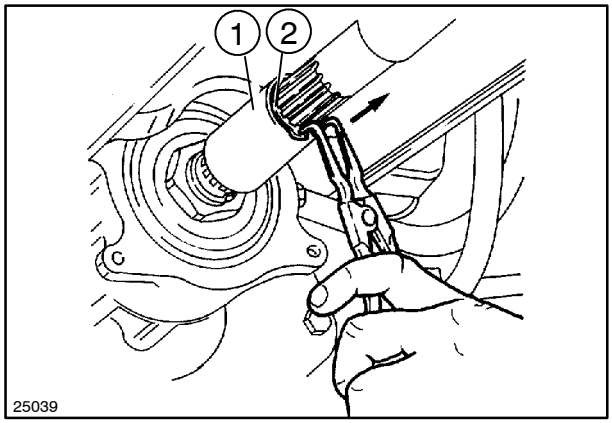
27

24. Unscrew the front central and rear retaining bolts on the front axle shaft guard, then remove the guard (1).



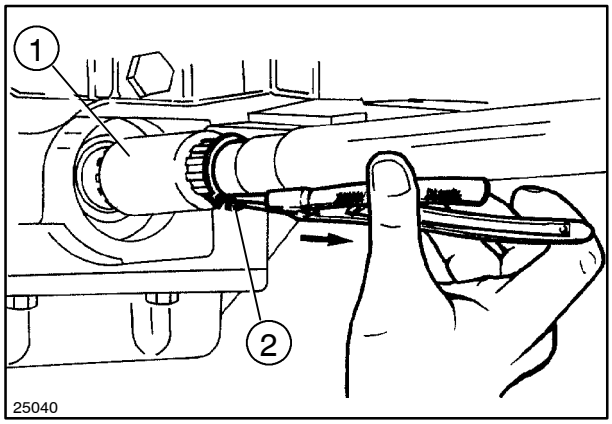
28

25. Remove the circlip (2) and move the sleeve (1) in the direction indicated by the arrow until it is released from the groove on the front axle.



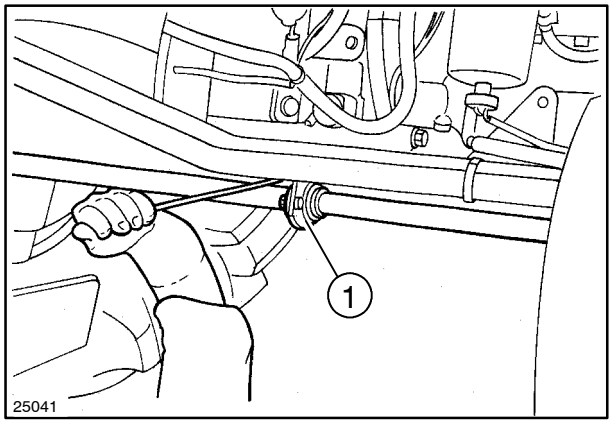
29

26. Remove the circlip (2) and move the sleeve (1) in the direction indicated by the arrow until it is released from the groove on the drive.



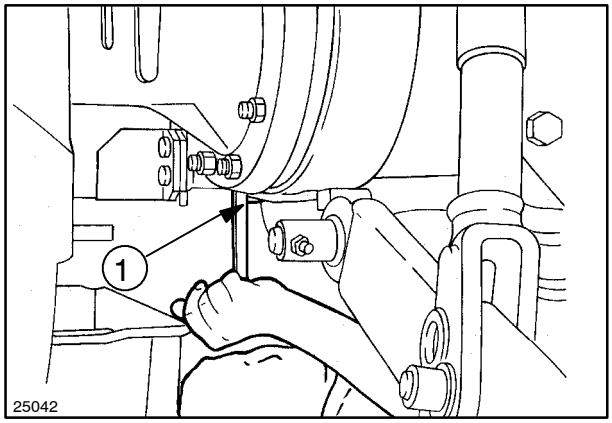
30

27. Remove the drive shaft central support (1) retaining bolts and extract the shaft together with the support.



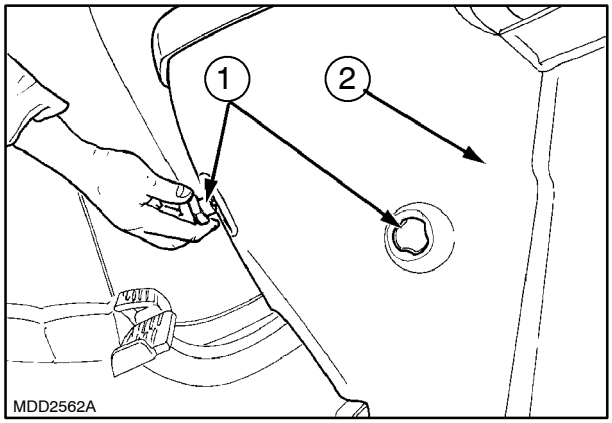
31

28. Detach the 4WD engagement distributor oil delivery line (1).



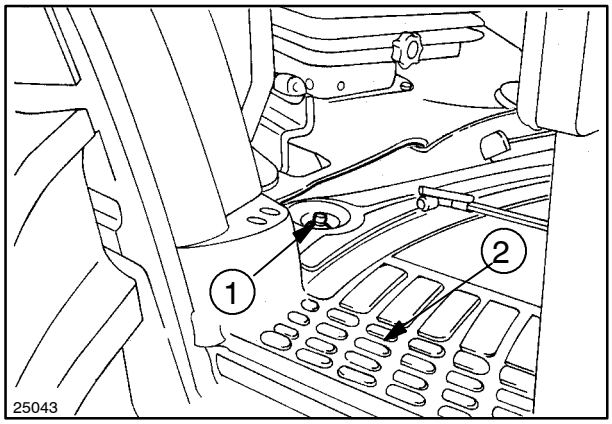
32

29. Remove the four knobs (1) and take off the two dashboard panels (2).



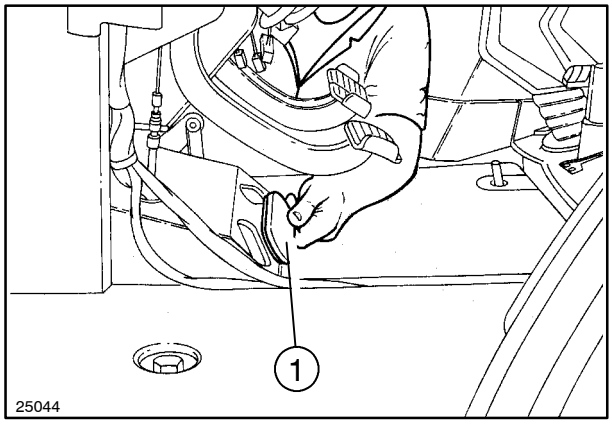
33

30. Extract the differential lock pedal lock pin (1), remove the pedal and extract the footboard (2).



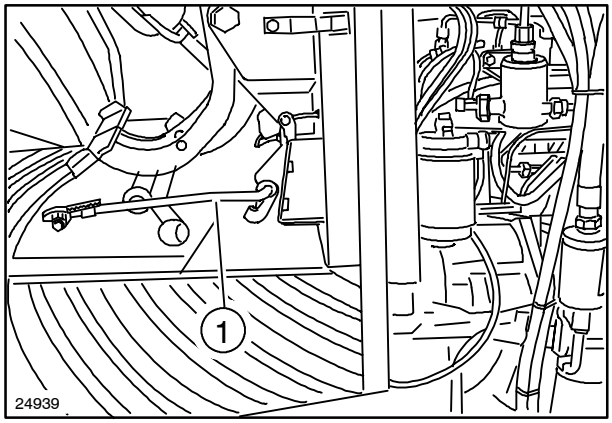
34

31. Remove the caps (1) to access the engine upper retaining bolts.



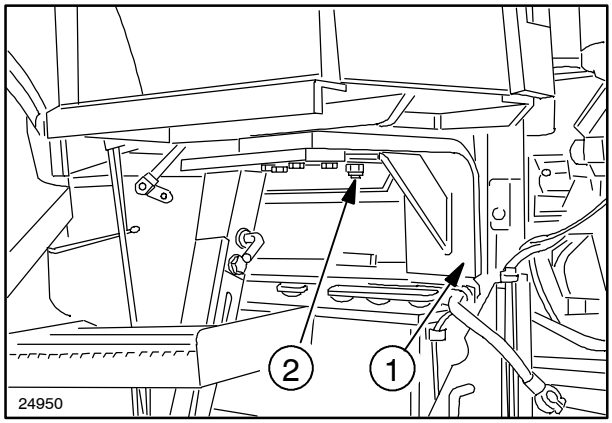
35

32. Detach the accelerator cable from the pedal (1).



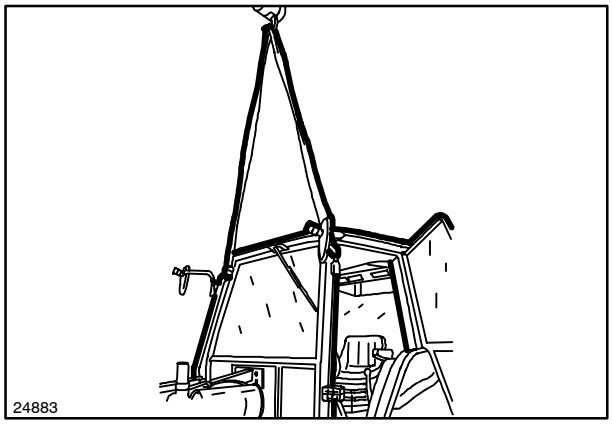
36

33. Remove the front nuts (2, one on each side) securing the cab to the silent-block supports (1).



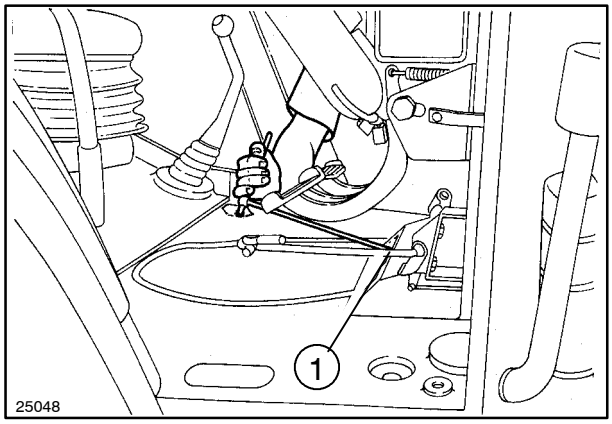
37

34. Raise the cab from the front by approximately 2.3622 in. (6 cm).



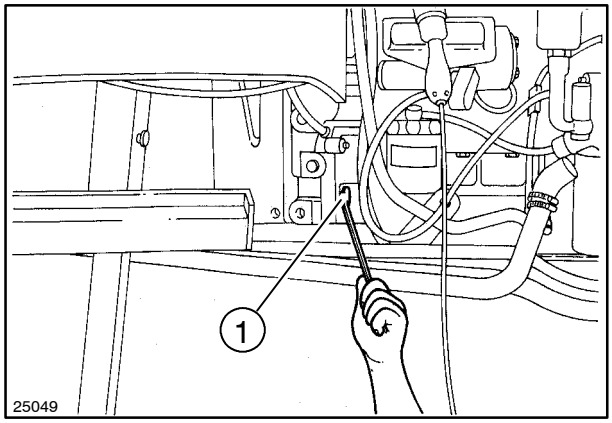
38

35. Unscrew the two nuts securing the engine to the transmission, working through the two slots (1).



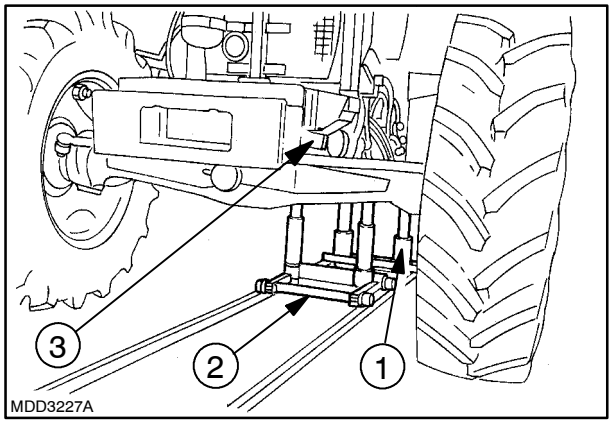
39

36. Unscrew the four lower bolts (1) securing the engine to the transmission.



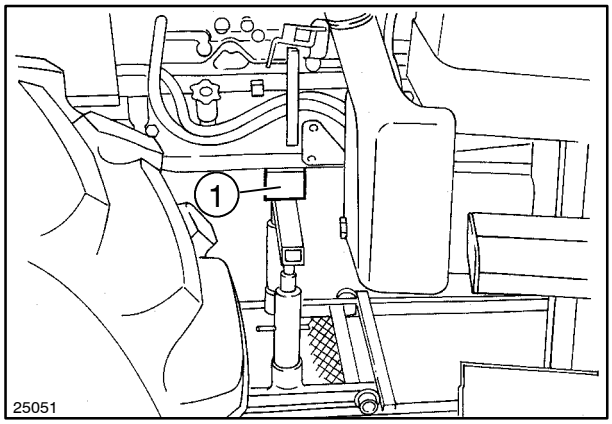
40

37. Place two wedges (3) on the front axle to prevent the engine oscillating on the axle pivot, position the tractor disassembly stand **380000236**, fitting the fixed support (1) under the rear transmission casing near the engine flange and the mobile support (2) under the engine, near the transmission casing flange, as shown in fig. 42.



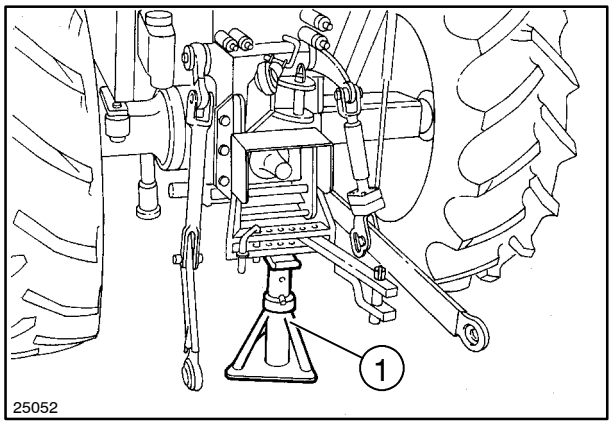
41

38. Position another mobile support on **380000236** under the front ballast support to prevent the engine from rotating or overturning forwards when the transmission casing is removed.
39. Position wooden blocks (1) between the stand and the tractor, adjust the height of the stand with the screws, bringing the blocks (1) into contact with the tractor.



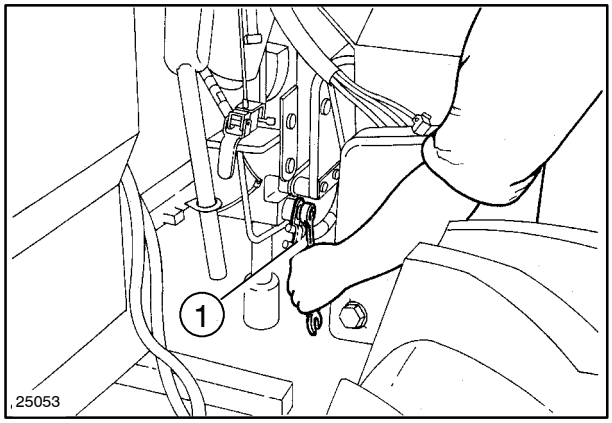
42

40. Position a fixed stand (1) under the towbar and apply the handbrake.



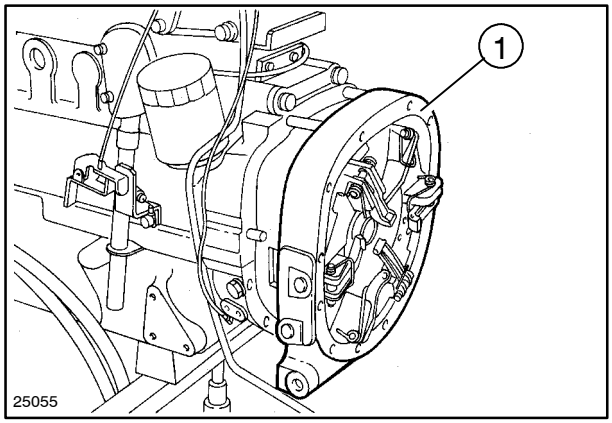
43

41. Detach the cab heating pipes support bracket (1).
42. Remove the remaining four engine/transmission retaining bolts.
43. Disconnect the two electrical connectors on the right-hand side of the dashboard.
44. Separate the engine from the transmission.



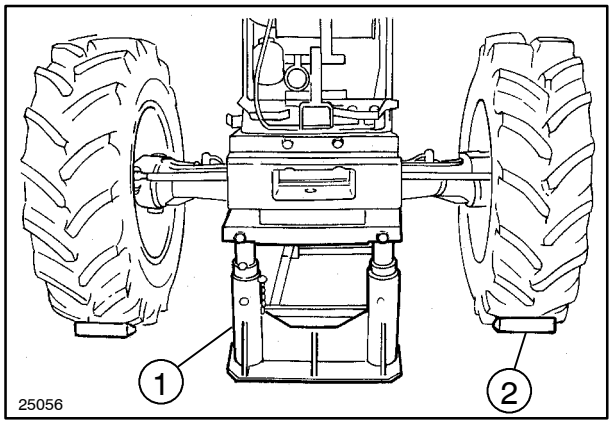
44

45. Remove the spacer (1) located between the engine and the transmission.



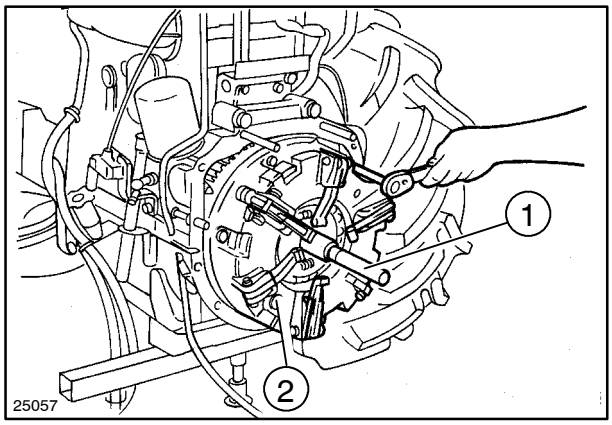
45

46. Position a fixed stand (1) under the ballast support and wedge the front wheels with wooden chocks (2).



46

47. Insert tool (1) **380000292** in the hole on the clutch, unscrew the six clutch/flywheel retaining bolts (2) and remove the assembly.



47

48. To reassemble the engine proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Assemble the clutch using pin **380000292** and secure the clutch to the engine flywheel with the six bolts.
- Adjust the coplanarity of the clutch disengagement levers, as described on page 25.
- Clean the spacer and the contact surfaces with the clutch casing, also scrape away any remaining sealing compound on the engine surface.
- Apply LOCTITE sealing compound on the engine/spacer contact surfaces and fit the spacer on the stud bolts screwed into the engine.
- Also apply LOCTITE sealing compound on the clutch casing contact surfaces.
- Put wooden chocks under the rear wheels, make sure that the handbrake is applied and that the fixed and mobile stands are positioned correctly.
- Move the engine/front axle assembly towards the clutch casing, pushing the front wheels. During this operation care must be taken with the rigid oil intake and 4WD control valve pipes also make sure that cables or wires do not remain crushed between the two assemblies.
- Then rotate the engine shaft, by turning the cooling fan, to allow the sleeve and PTO shaft to engage.
- Insert and tighten the engine/clutch casing retaining bolts.
- Hitch the two slings, attached to the cab handrail, to a hoist.
- Raise the front part of the cab by 2.3622 in. (6 cm).
- Assemble the brake pipes support bracket, on the right-hand side, lower the hoist and unhitch the slings from the handrail.
- Remove the stands from tool **380000236** under the engine and the gear-transmission casing, and the stand under the towbar support.
- Secure the cab with the two front retaining bolts.
- Reconnect the hose on the injector excess fuel line.
- Reconnect the pipe to the thermostarter glow-plug and dehydrator filter.
- Refit the fuel filter support and secure to the engine body, then reconnect the two semi-rigid pipes to the support.
- Reconnect the oil delivery and return pipes from the power steering control valve to the anticavitation chambers.
- Refit the oil priming lines on the pumps and secure the rubber sleeves with the clamps.
- Refit the lift control valve oil delivery pipe on the relative pump and reposition the o-ring seal.

- Secure the three lines with adjustable metal clamps.

- Reconnect the electrical connections on the vertical connector bracket.

- Refit the cab heating pipes union on the spacer located between the engine and the clutch casing, and reconnect the rubber hoses to the union.

- Connect the two power steering hoses to the union located on the left-hand side of the front axle, fit the two pipes with the special clamp, and attach the clamp to the tractor body with a bolt.

- Refit the rev counter/hourmeter and secure the sheath with the relative clamp.

- Fit the silencer on the exhaust manifold, inserting the gas seal, attach the front part of the silencer to the support bracket and attach the filter connecting hose to the exhaust ejector.

- Fit the bonnet support bracket to the radiator bracket.

- Reconnect the 4WD distributor oil delivery line and the rear differential lock.

- Refit the 4WD shaft and the guard.

- Reconnect the accelerator cable to the pedal.

- Fit the clutch cable on the pedal and secure the sheath on the stop bracket.

- Reposition the plastic caps in the slots on the cab flooring and footboard.

- Refit the steering column panels.

- Refit the engine fan lateral guards.

- Refit the bonnet by inserting the pivots on the relative support bracket, reattach the two pneumatic pistons on the bonnet and connect the headlight connections.

- Refit the secondary bracket (battery support) to the clutch overdrive casing. Fit the rotating bracket with the battery on the fixed bracket.

- Refit the front ballast.

- Assemble the support bracket and the tool box.

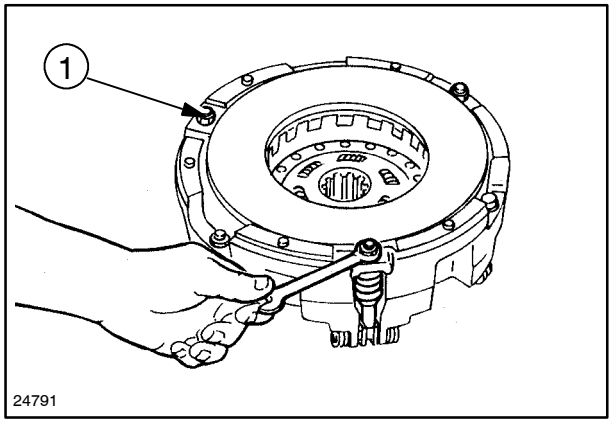
- Refill the transmission casing with the oil that was previously drained off.

- Fill the radiator with coolant.

- Reconnect the battery leads and replace the plastic guard.

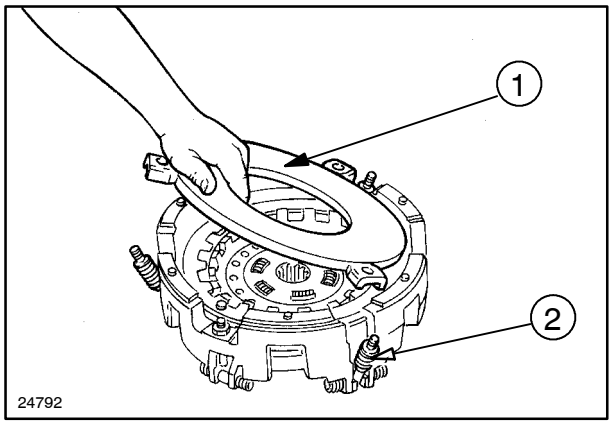
Op. 18 110 30
12”/12” DUAL CLUTCH
Test bench overhaul and adjustment

1. Unscrew the three PTO clutch lever adjustment nuts (1).



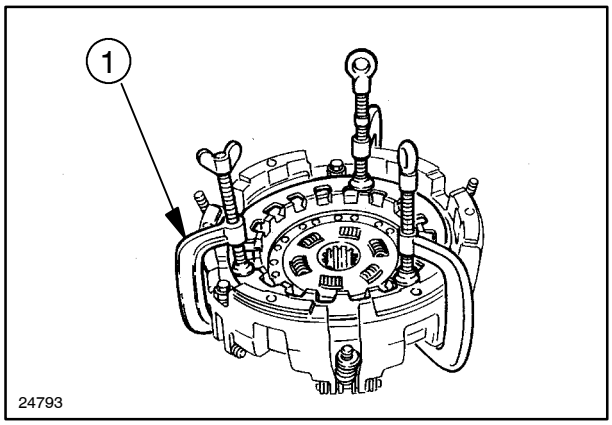
48

2. Recover the pressure plate (1) with the three coil springs (2) and the three washers.



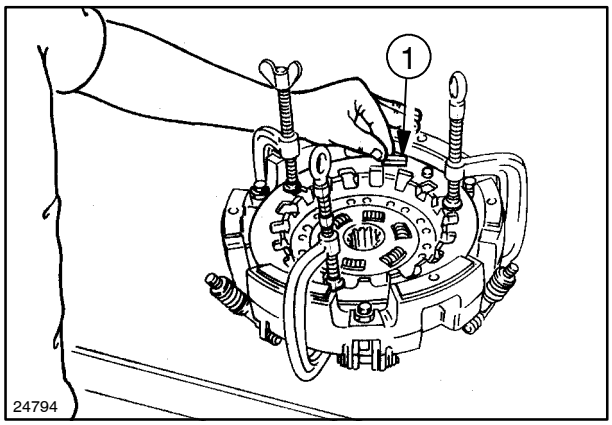
49

3. Position three clamps (1) at intervals of 120° on the clutch body and gradually and carefully squeeze the Belleville spring disk.



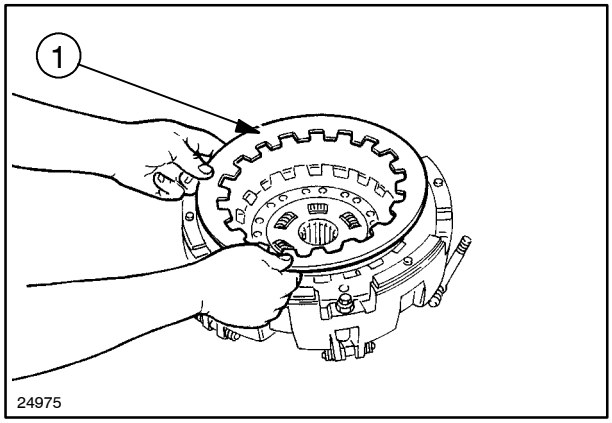
50

4. Extract the six spring retaining pins (1) from their seats.



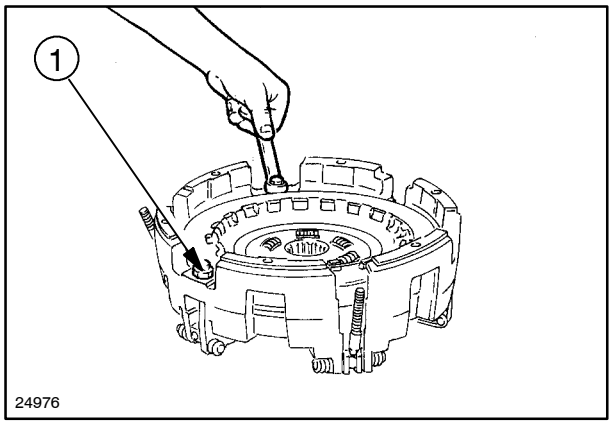
51

5. Remove the three clamps and extract the Belleville spring disk (1).



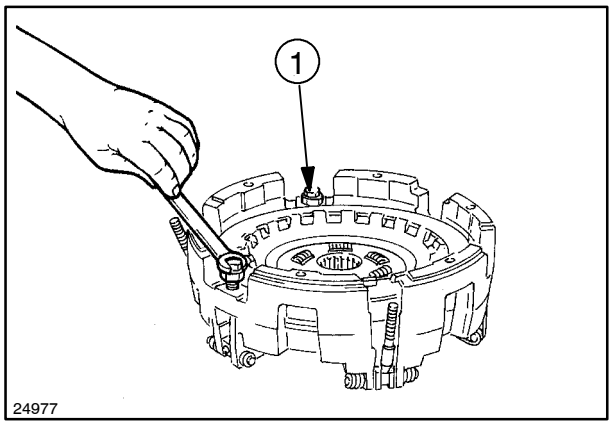
52

6. Loosen the three locknuts (1) on the main clutch lever adjustment screws.



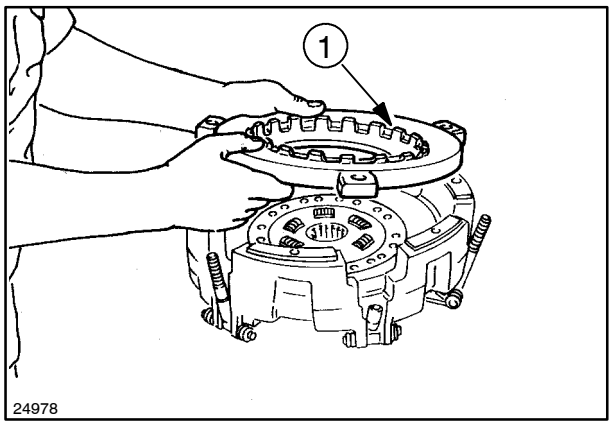
53

7. Remove the three main clutch lever adjustment screws (1).



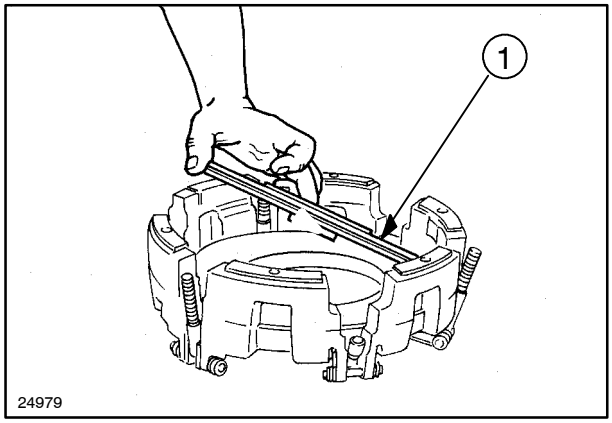
54

8. Extract the main clutch pressure plate (1).



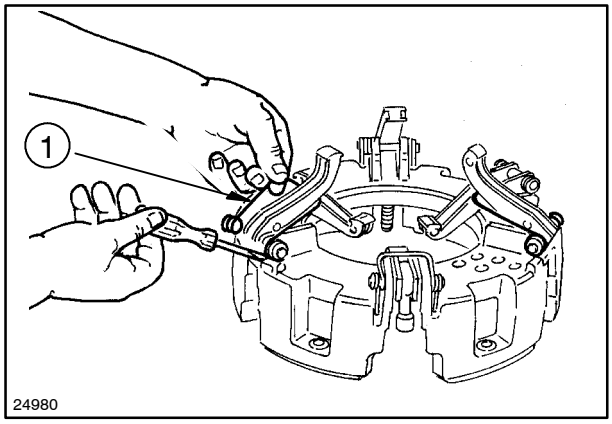
55

9. Extract the main clutch disk (1).



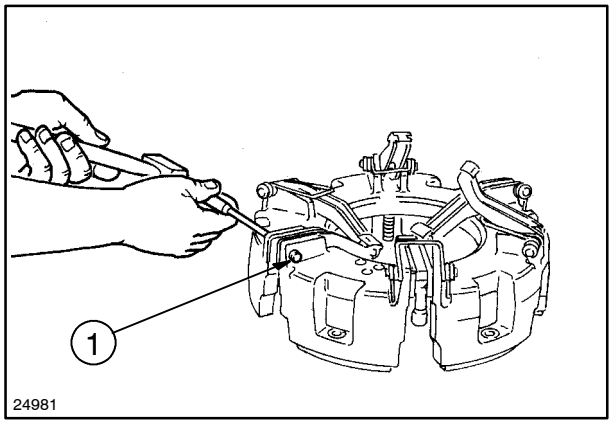
56

10. Remove the springs (1) on the PTO clutch control levers.



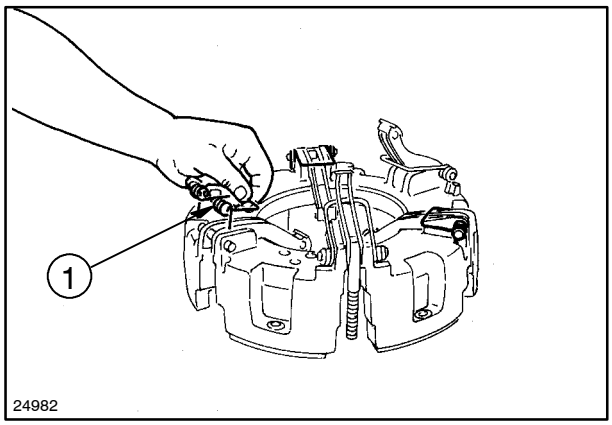
57

11. Extract the pivot pins (1) on the PTO clutch control levers.



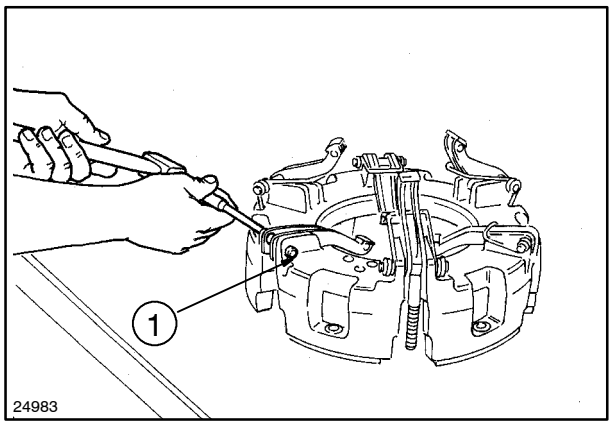
58

12. Remove the springs (1) on the main clutch control levers.



59

13. Extract the pivot pins (1) on the main clutch control levers.



60

14. In order to assemble the 12”/12” dual clutch, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refit the lever pivot pins and the relative springs.

- Refit the main clutch disk in the clutch housing.

- Install the main clutch pressure plate, securing to the pins with the bolts.

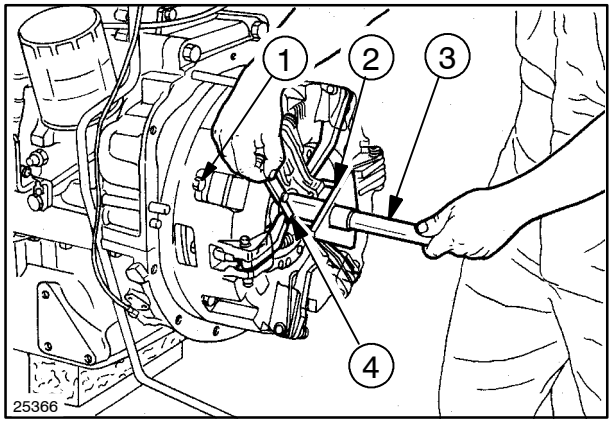
- Install the Belleville spring disk, carefully position the three clamps and evenly and progressively compress the spring. Insert the six pins, making sure that they are securely inserted in their respective seats, then remove the clamps.

- Install the PTO clutch disk; fit the three washers and the coil springs on the pins and secure with the three nuts.

COPLANARITY ADJUSTMENT OF DUAL CLUTCH RELEASE LEVERS

1. After overhauling the clutch, fit centering pin **380000292** (3) and fit the entire clutch assembly with PTO disk to the flywheel, then tighten the bolts (1) to the torque value given on page 3.

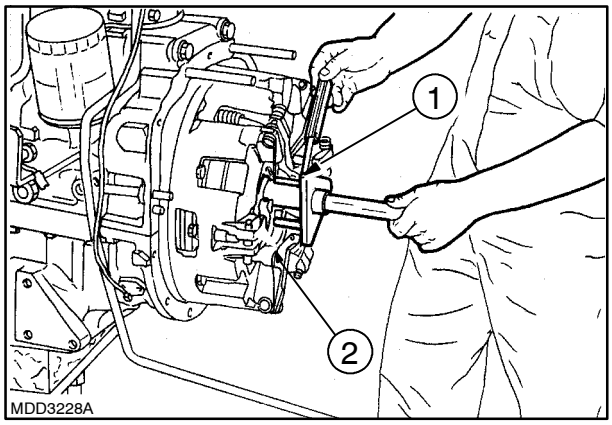
   Fit gauge **380000293** (2) and, using a feeler gauge, adjust the clutch release levers (4) to obtain a clearance of 0.0393 in. (0.1 mm).



61

2. Rotate the gauge **380000293** (1) and, using a feeler gauge, adjust the PTO clutch release levers (2) to obtain a clearance of 0.0393 in. (0.1 mm).

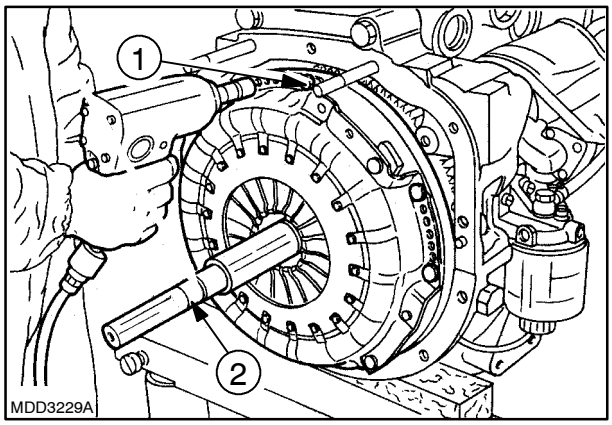
   Remove tools no. **380000293** and **380000292**.



62

SINGLE DISK CLUTCH

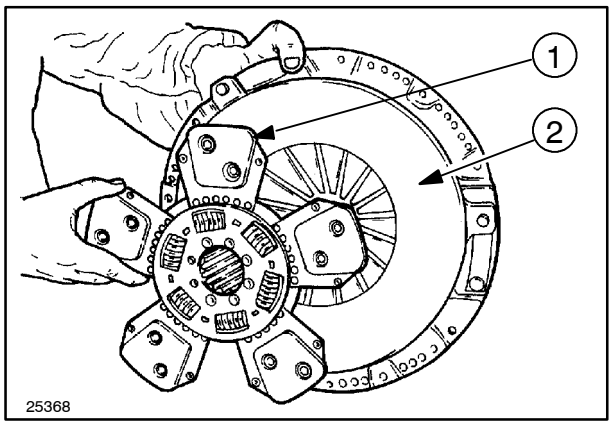
1. Insert centering pin **380000292** (2), unscrew the flywheel retaining bolts (1) and remove the clutch unit.



63

2. Check the disk (1) for wear and replace the linings if they have worn down (or are nearly worn down) to the plate.

   In the event of pressure plate (2) breakdown replace the entire part.



64

SECTION 21 - TRANSMISSIONS

Chapter 1 - Transmission and range gear (12 x 4)

CONTENTS

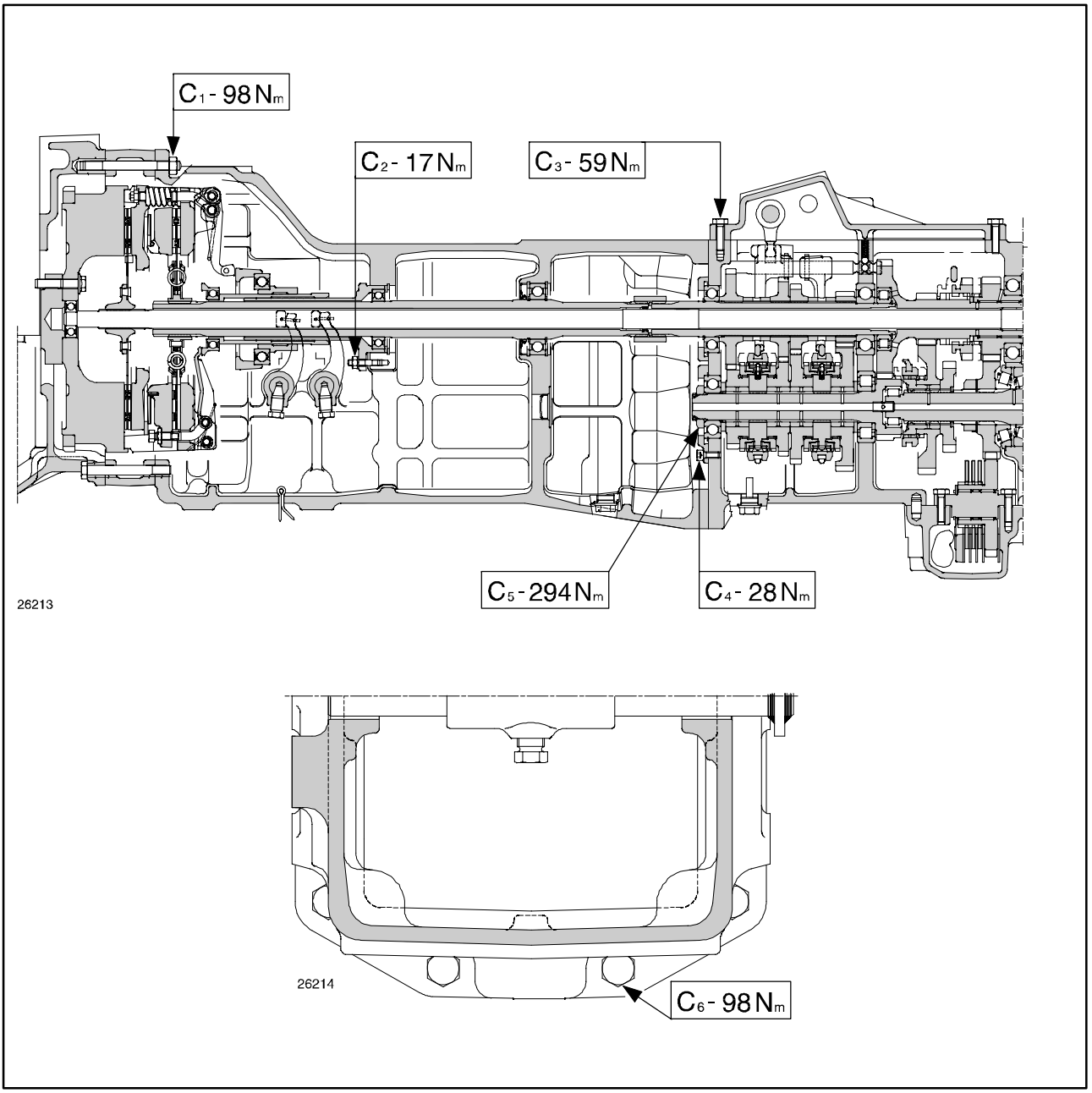
Operation	Description	Page
	Transmission and range gear. Data	2
	Tightening Torques	3
	Tools	4
	Cross-sectional views	6
	Description and Operation	8
	Fault diagnosis	8
	Gearbox/transmission casing R.I.	(See operation **21 118 12**)*
	Gearbox/transmission casing D.A. and adjustments	(See operation **21 118 85**)*

*Note: These operations are covered in Section 27.

TRANSMISSION AND RANGE GEAR DATA

Gearbox		4 speed, constant-mesh, with synchronisers on all gears
Gearing type		helical
Reducer		ordinary gear train with 3 forward gears and 1 reverse gear, making a total of 12 forward and 4 reverse gears
- gearing type		spur
- reduction ratios:		
● low		$\frac{23x17}{43x50}$ = 1:5,49
● intermediate		$\frac{23x27}{43x34}$ = 1:2,35
● high		1
Gearbox and range gear operating system		independent, by means of two hand levers located on the right-hand side of the operator
Thickness of gearbox driving shaft adjustment ring (5, fig. 5)	inc. (mm)	0.1181 - 0.1279 - 0.1377 - 0.1476 -0.1574 (3.00-3.25-3.50-3.75-4.00)
Inside diameter of gearbox driven gears	inc. (mm)	1.9704 to 1.9714 (50.050 to 50.075)
External diameter of relative bushings (17)	inc. (mm)	1.9655 to 1.9665 (49.925 to 49.950)
Clearance between gears and bushings	inc. (mm)	0.0039 to 0.0059 (0.100 to 0.150)
Diameter of gearbox driven shaft (19)	inc. (mm)	1.5423 to 1.5429 (39.175 to 39.191)
Inside diameter of bushings (17)	inc. (mm)	1.5433 to 1.5448 (39.200 to 39.239)
Clearance between shaft and bushings	inc. (mm)	0.0003 to 0.0025 (0.009 to 0.064)
PTO clutch shaft diameter (4)	inc. (mm)	0.9834 to 0.9842 (24.979 to 25.000)
Installed bush internal diameter (1)	inc. (mm)	0.9858 to 0.9878 (25.040 to 25.092) ([1])
Clearance between PTO clutch shaft and relative bushing	inc. (mm)	0.0015 to 0.0044a (0.040 to 0.113)
Bush instalment interference on transmission drive shaft	inc. (mm))	0.0014 to 0.0035 (0.037 to 0.091)
Springs (16, fig. 6) for transmission and range gear poppet balls:		
- spring free length	inc. (mm)	1.1811 (30)
- spring length under load of 50 to 56 N (5.13 to 5.67 kg)	inc. (mm)	1.0039 (25,5)
Gear and range gear lever retaining springs:		
- spring free length	inc. (mm)	2.9527 (75)
- spring length under load of 94 to 104 N (9.6 to 10.6 kg)	inc. (mm)	1.6535 (42)

(1) Value to be obtained without grinding operations.



1

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Bolts or nuts securing reverser-clutch casing and creeper to the engine (C_1)	M 12 x 1.25	98	10
Sleeve cover nuts (C_2)	M 8 x 1.25	17	1.7
Rear transmission-gearbox casing upper cover retaining bolts (C_3)	M 10 x 1.25	59	6
Transmission driving and driven shaft bearings cover retaining bolts (C_4)	M 8 x 1.25	28	2.9
Driven gear shaft locknut (C_5)	M 32 x 1.5	294	30
Creeper reverser-clutch casing/rear transmission-gearbox casing retaining bolts (C_6)	M 12 x 1.25	98	10

TOOLS

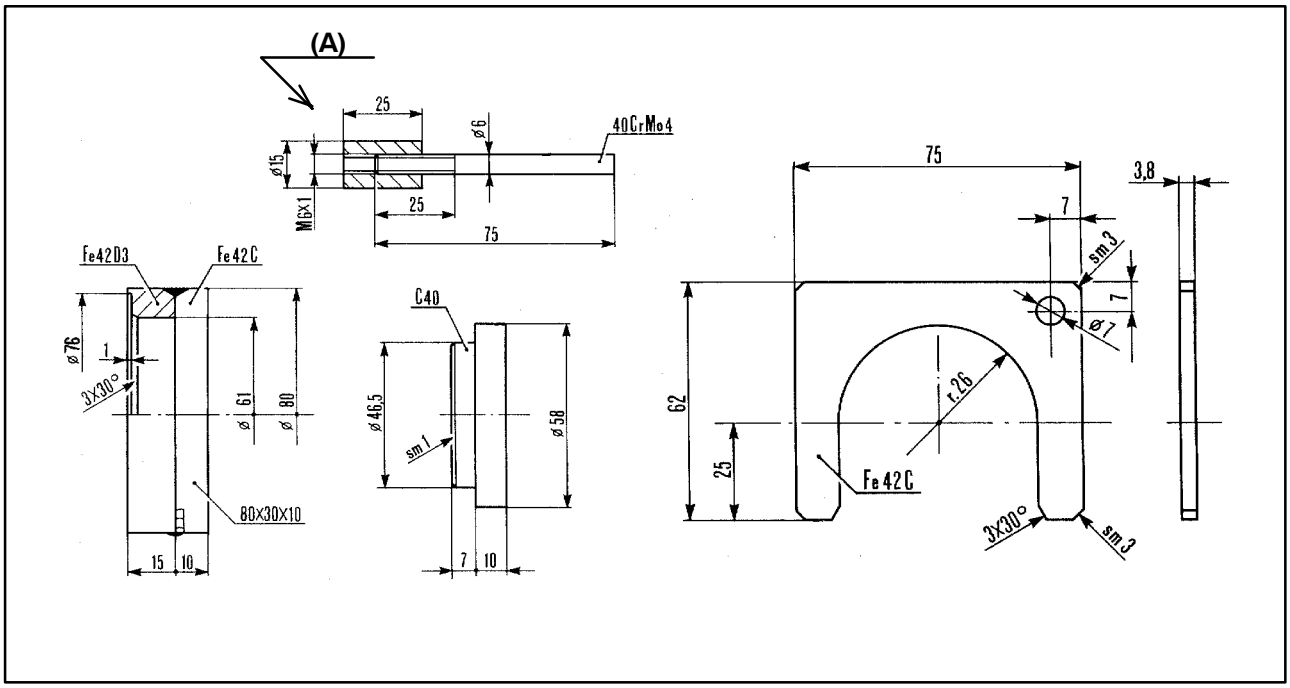
WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**.

To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

380000236	Tractor disassembly trolley.
380000227	Clutch casing lift hook.
380000301	Rotating stand for overhaul operations.
380000271	Front bracket (with **380000301**).
380000272	Rear bracket (with **380000301**).

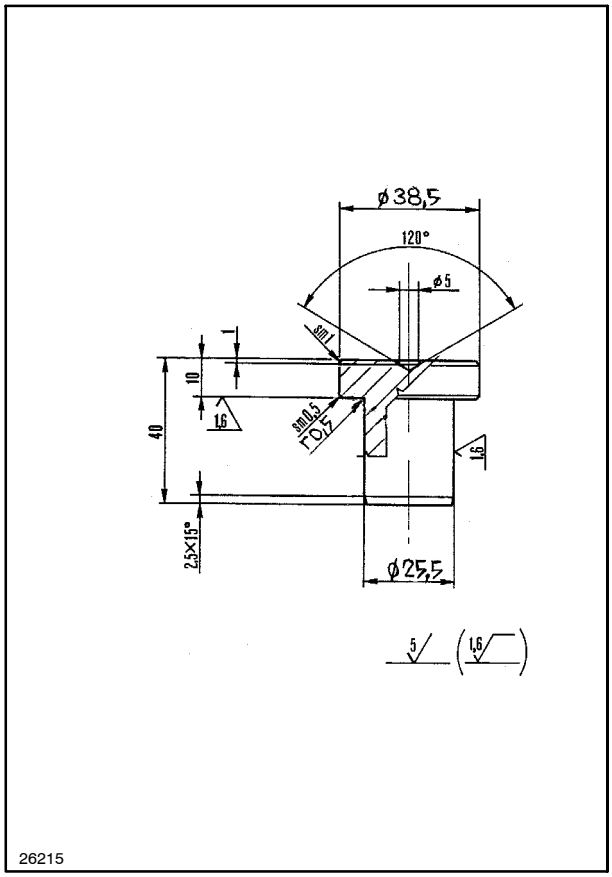


2

Tool to make for disassembly of reduction unit driven shaft rear bearing and intermediate gear driving gear unit (stamp no. 50028 on the part - Measurements in mm).
Make in UNI C40 material.

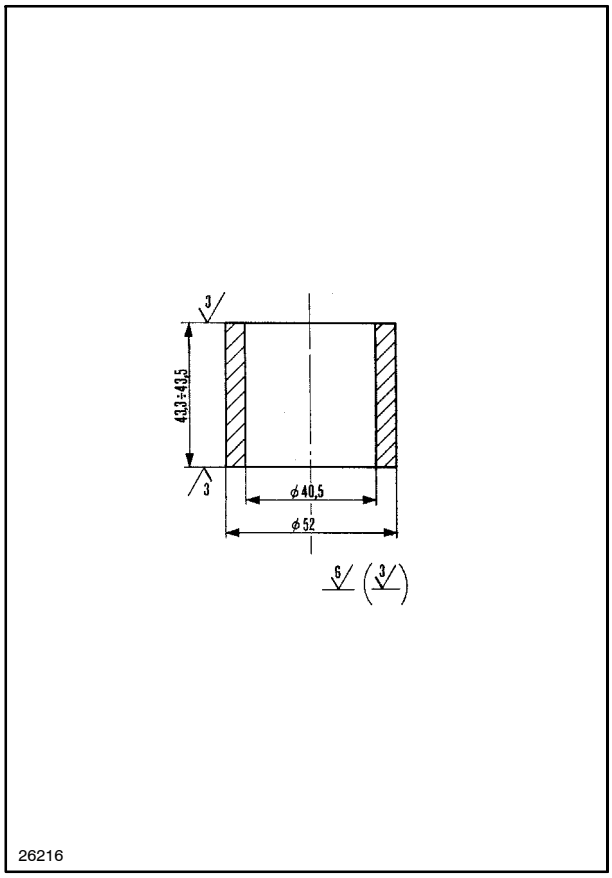
NOTE: *Part* ***(A)*** *must be duplicated.*

Punch to make for gearbox driving shaft disassembly (mark part with No. 50006 on the part - Measurements in mm).
Make in UNI C40 material.

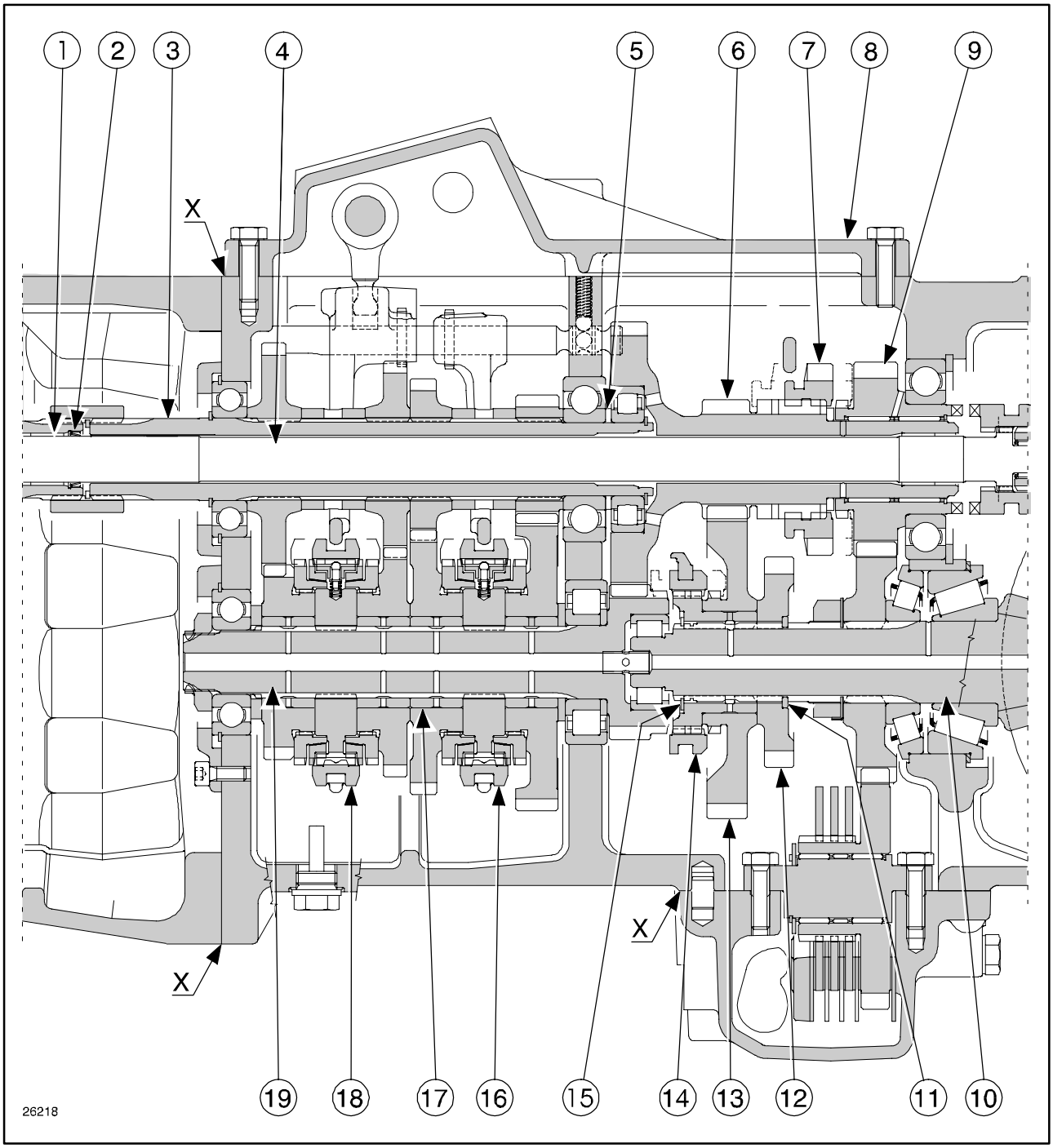


3

Tool to make for adjusting the gearbox driving shaft bearings (mark part with No. 50007 on the part - Measurements in mm).
Build using Aq 45.



4

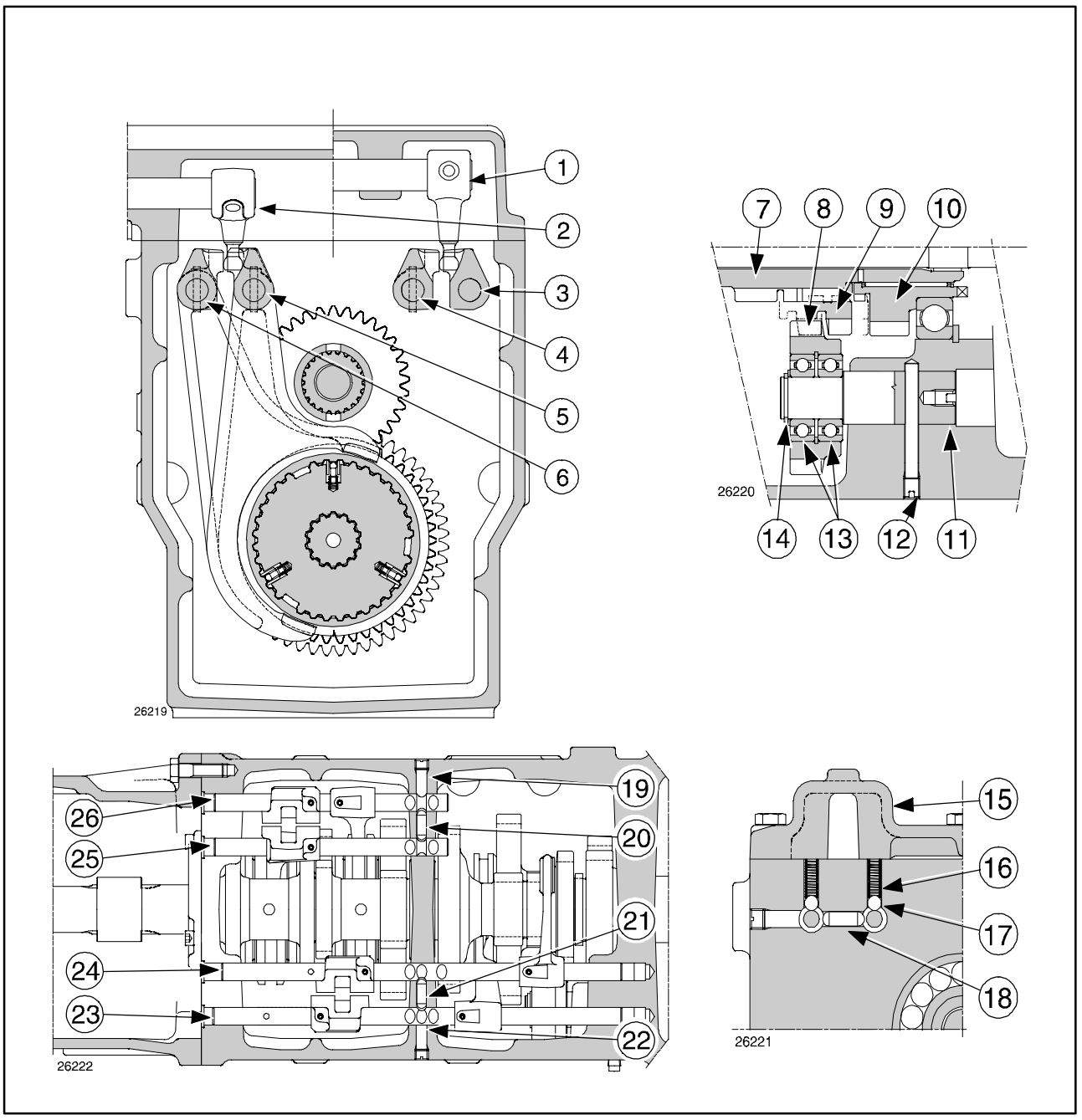


5

Longitudinal cross-sectional view of gearbox and gear range.

1. PTO shaft support bush.
2. Seal.
3. Gearbox driving shaft.
4. Power take-off shaft.
5. Driving shaft adjustment ring.
6. Range gear driving shaft.
7. Reverse and intermediate gear unit.
8. Top cover.
9. Intermediate gear driving gear.
10. Bevel pinion shaft.
11. Stop half rings.
12. Reverse driven gear.
13. Low gear driven gear.
14. Low - high range gear engagement sleeve.
15. Circlip.
16. 1st and 2nd gear engagement synchroniser.
17. Driven gears support bushing.
18. 3rd and 4th gear engagement synchroniser.
19. Gearbox driven shaft.

NOTE: *On assembly apply a bead of sealing compound to the surfaces* ***X*** *as indicated on page 26, chap. 4.*



6

Transmission and range gear cross-sectional views

1. Range gear transmission rod.
2. Transmission control rod.
3. Low and high gear engagement rod.
4. Intermediate and reverse gear engagement rod.
5. 3rd and 4th gear engagement rod.
6. 1st and 2nd gear engagement rod.
7. Range gear driving shaft.
8. Reverse intermediate gear.
9. Intermediate gear and reverse gear unit.
10. Intermediate gear driving gear.
11. Intermediate gear pin (8).
12. Pivot retaining bolt (11).
13. Bearings.
14. Circlip.
15. Transmission-gearbox casing upper cover.
16. Spring.
17. Poppet ball.
18. Gear safety pawl.
19. Plug.
20. Gear safety pawl.
21. Range safety pawl.
22. Plug.
23. Low and high gear engagement rod.
24. Intermediate and reverse gear engagement rod.
25. 3rd and 4th gear engagement rod.
26. 1st and 2nd gear engagement rod.

NOTE: *Before tightening plugs (19 and 22) they must be smeared with one of the sealing compounds listed in* ***Section 00****.*

DESCRIPTION AND OPERATION

4-speed gearbox with constant-mesh helical gears controlled by two synchronizers.

The range gear has cascade-type constant-mesh spur gears, excluding reverse.

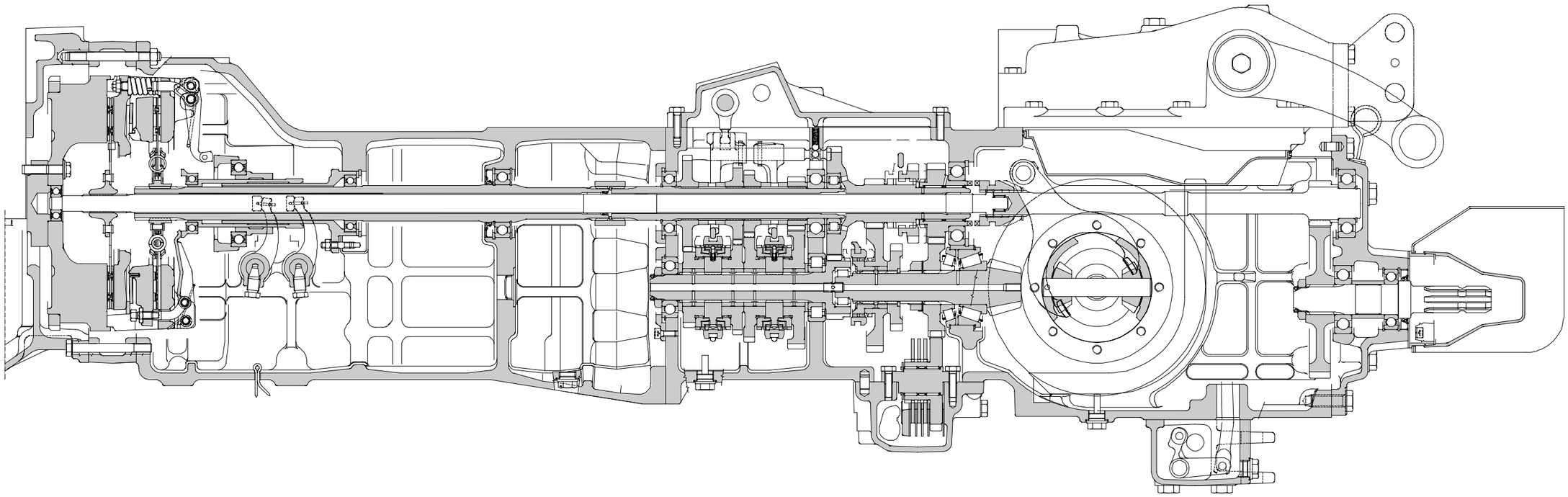
The driven gears are splined directly on the bevel pinion shaft.

This provides: 3 forward gear ranges and one reverse gear.

The gearbox and the range gears are controlled by two independent levers located on the right-hand side of the operator.

TRANSMISSION AND RANGE GEAR TROUBLESHOOTING

Problems	Possible Causes	Solutions
Spontaneous disengagement of gearbox and range gear.	1. External levers and relay rods incorrectly adjusted.	Adjust correctly.
	2. Control lever retaining springs damaged.	Renew the springs.
	3. Synchroniser teeth or selection sleeves damaged.	Remove the transmission-gearbox casing and replace the synchronisers or the sleeves.
	4. Engagement stroke incomplete.	Eliminate the cause and reset the complete stroke.
Difficulty in engaging the gearbox and range gear.	1. External levers and relay rods incorrectly adjusted.	Adjust correctly.
	2. Stiffness and/or partial seizure of external levers and relay rods.	Check rod pivots and lubricate.
	3. Main clutch dragging.	See page 5, Section 18.
	4. Synchronisers or selection sleeves damaged.	Remove the transmission-gearbox casing and replace the synchronisers or the sleeves.
	5. Internal controls do not slide easily: rods, forks and sleeves.	Overhaul the controls.
Excessive noise in gearbox or range gear.	1. Worn or damaged internal parts.	Detach the transmission-gearbox casing and replace the damaged parts.



26237

Longitudinal cross-sectional view of gearbox and gear range. 7

SECTION 21 - TRANSMISSIONS

Chapter 2 - Reverser

CONTENTS

Operation	Description	Page
	Transmission with range gear and reverser. Data	2
	Tightening Torques	3
	Tools	4
	Cross-sectional views	4
	Description and Operation	6
	Fault diagnosis	6
21 110 85	Clutch-reverser casing. Disassembly-Assembly	7

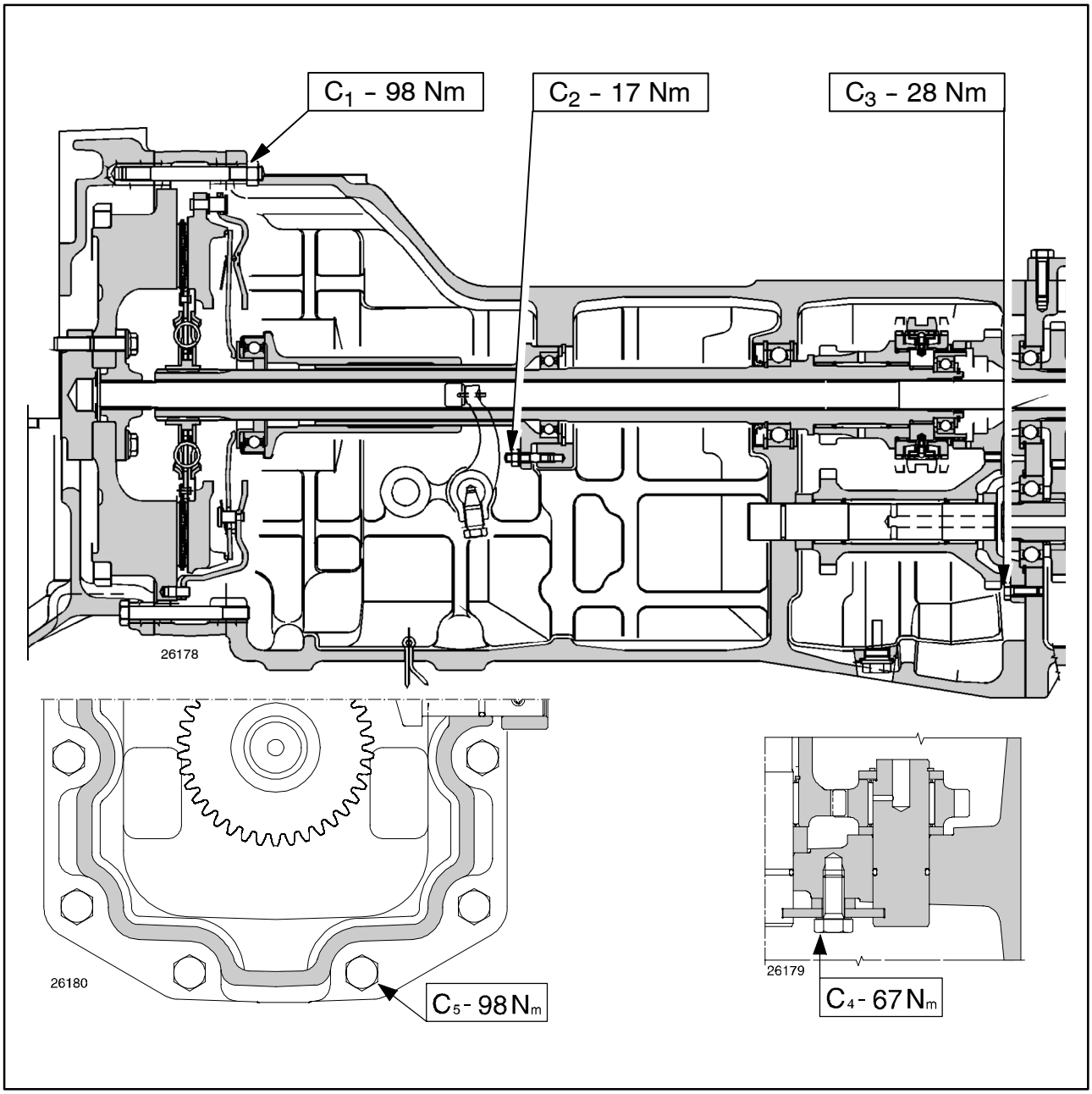
REVERSER DATA

Type	mechanical type with spur gearing, located between the main clutch and the gearbox. Composed of no. 1 driving gear, no. 1 intermediate gear and no. 1 intermediate gear
Operating	with hand lever located on left-hand side of the operator

TRANSMISSION AND RANGE GEAR DATA

Gearbox	4 speed, constant-mesh, with synchronisers on all gears
Gearing type	helical
Reducer	ordinary gear train with 3 ranges for a total of 12 gears
- gearing type	spur
- reduction ratios:	
• low	$\frac{23x17}{43x50}$ = 1:5.49
• intermediate	$\frac{23x27}{43x34}$ = 1:2.35
• high	1
Gearbox and range gear operating system	independent, by means of two hand levers located on the right-hand side of the operator

For missing data see Chapter 1



1

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Bolts or nuts securing clutch-reverser casing to the engine (C_1)	M 12 x 1.25	98	10
Sleeve cover retaining nuts (C_2)	M 8 x 1.25	17	1.7
Reverser driven shaft support cover retaining bolts (C_3)	M 8 x 1.25	28	2.9
Reverser driven shaft plate retaining bolt (C_4)	M 10 x 1.25	64	6.5
Clutch-reverser casing/rear transmission-gearbox casing retaining bolt (C_5)	M 12 x 1.25	98	10

TOOLS

WARNING

Warning - The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**.

To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

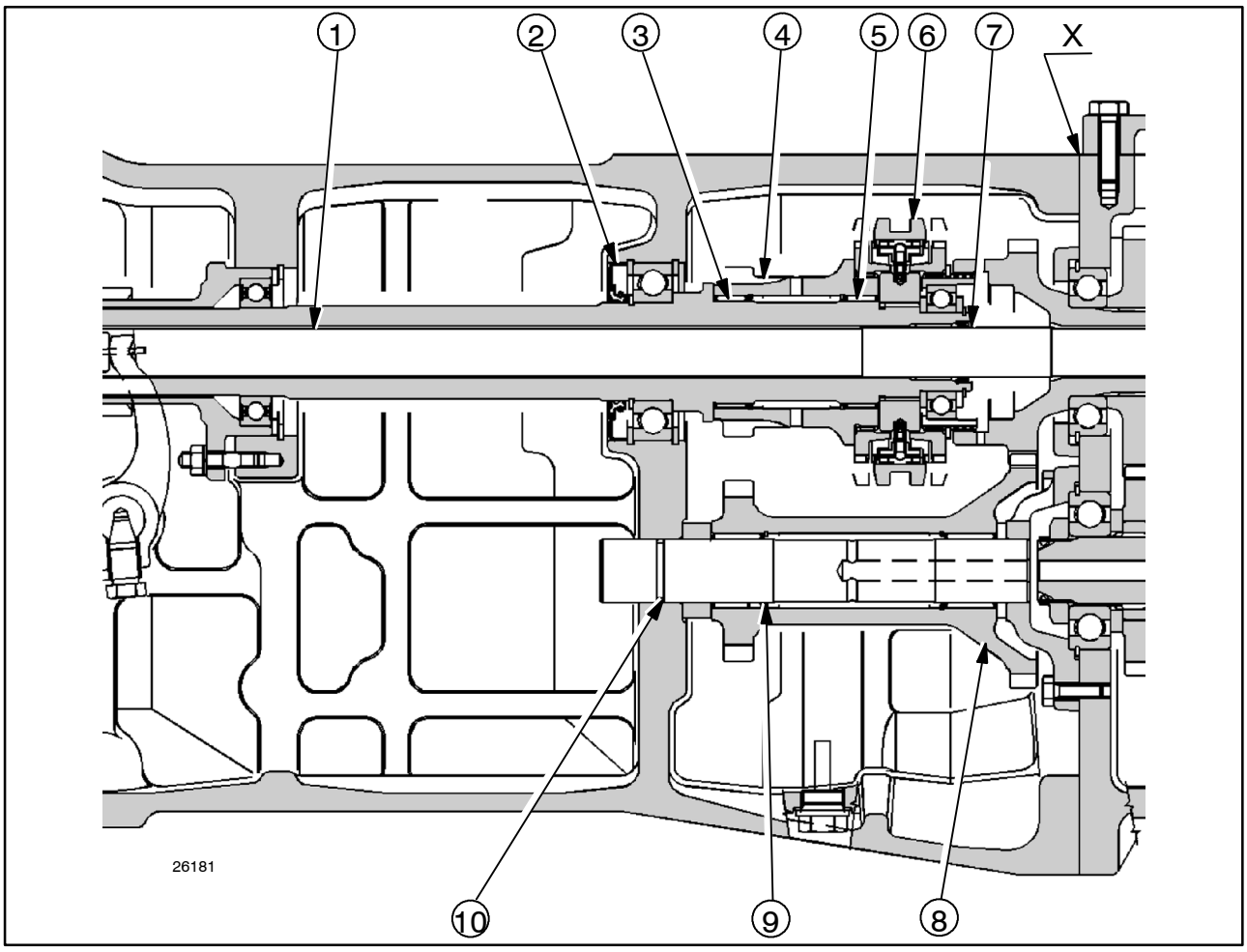
380000236 Tractor disassembly trolley.

380000227 Clutch casing lift hook.

380000301 Rotating stand for overhaul operations.

380000271 Front bracket (with **380000301**).

380000272 Rear bracket (with **380000301**).

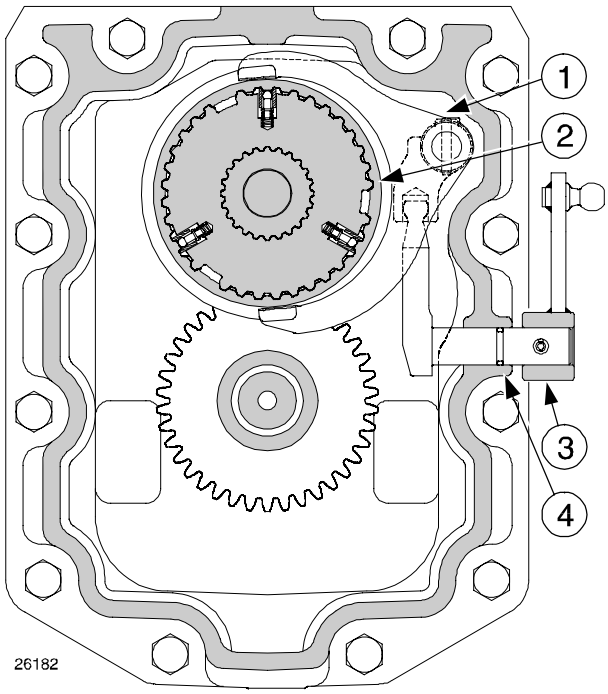


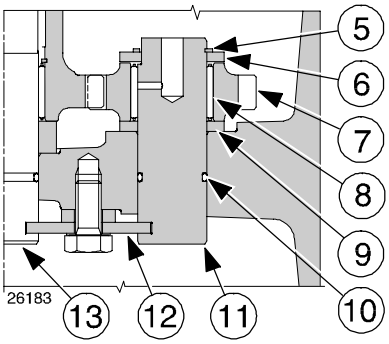
2

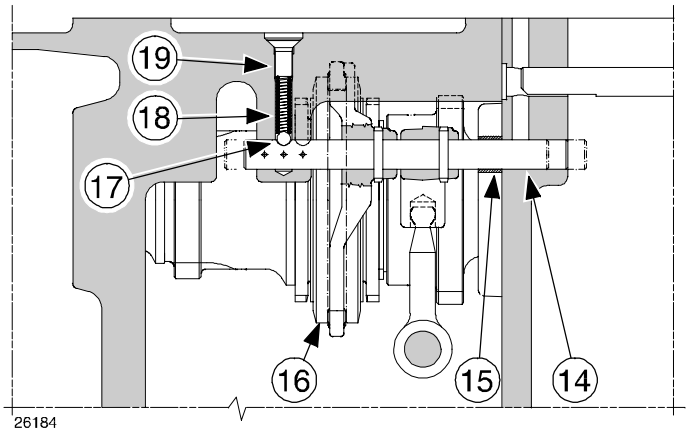
Reverser longitudinal section

1. Reverser shaft.
2. Seal.
3. Needle bearing.
4. Reverser drive gear unit.
5. Needle bearing.
6. Reverser control synchroniser.
7. Seal.
8. Reverser driven gear unit.
9. Driven gear pin (8).
10. Seal.

NOTE: *On assembly apply a bead of sealing compound to the surfaces* ***X*** *as indicated on page 26, chap. 4.*







3

Reverser cross-sectional views

1. Reverser control fork.
2. Reverser control synchroniser.
3. Reverser control external lever.
4. Seal.
5. Circlip.
6. Thrust washer.
7. Reverser intermediate gear unit.
8. Needle bearing.
9. Thrust washer.
10. Seal.
11. Intermediate gear journal (7).
12. Stop plate for journals (11 and 13).
13. Reverser driven gear pin.
14. Reverser control rod.
15. Spacer.
16. Reverser control synchroniser.
17. Poppet ball.
18. Ball spring (17).
19. Poppet ball retaining screw (the screw must be smeared with one of the sealing compounds listed in **Section 00**).

DESCRIPTION AND OPERATION

The reverser is a mechanical device making it possible to obtain 12 forward gears and 12 reverse gears. It is controlled by a lever located on the cab platform to the left of the operator.

The reverser is composed of a group of three spur gears: driving reverser gear, intermediate gear and driven reverser gear. Selection is effected by means of a synchroniser located in the gear unit.

The reverser is installed inside the clutch casing, between the clutch and the gearbox.

Lubrication is by means of the oil in the rear transmission–gearbox casing.

REVERSER TROUBLESHOOTING

Problems	Possible Causes	Solutions
Spontaneous reverser disengagement	1. External levers and relay rods incorrectly adjusted.	Adjust correctly.
	2. Synchroniser teeth damaged.	Remove the clutch casing and replace the synchroniser.
	3. Engagement stroke incomplete.	Eliminate the cause and reset the complete stroke.
Difficulty in engaging the reverser	1. External levers and relay rods incorrectly adjusted.	Adjust correctly.
	2. Stiffness and/or seizure of external levers and rods.	Check rod pivots and lubricate.
	3. Main clutch dragging.	See page 5, **Section 18**.
	4. Synchroniser damaged.	Remove the clutch casing and replace the synchroniser.
	5. Internal controls do not slide easily: rods, forks and sleeves.	Overhaul the controls.
Reverser is noisy	1. Worn or damaged internal parts.	Remove the clutch casing and replace the damaged parts.

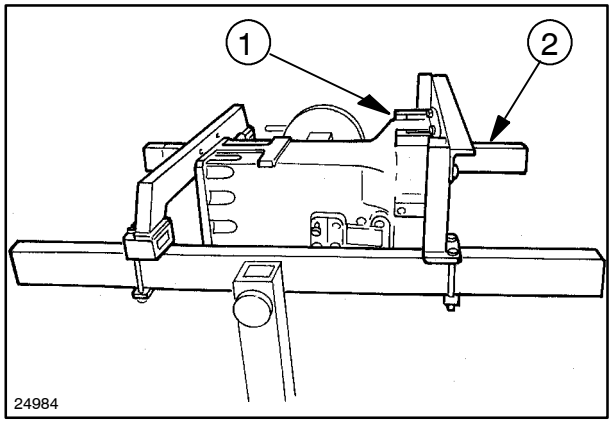
Op. 21 110 85
CLUTCH-REVERSER CASING D.A.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

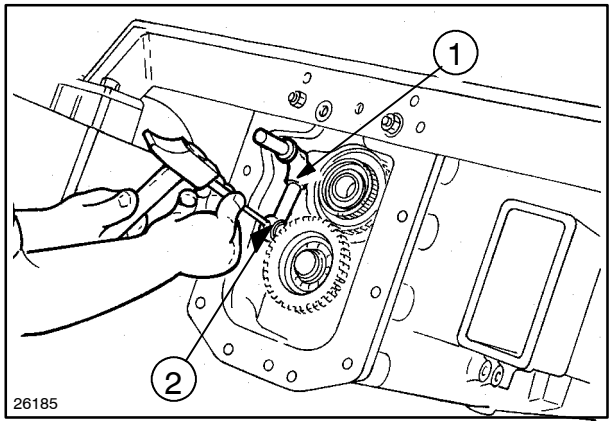
In order to work on the reverser, detach the cab or platform as described in **Section 90** and the clutch casing as described in **Section 4**. Then proceed as follows:

1. Secure the clutch-reverser casing (1) on the stand **380000301** (2) using the two brackets **380000271** and **380000272**.



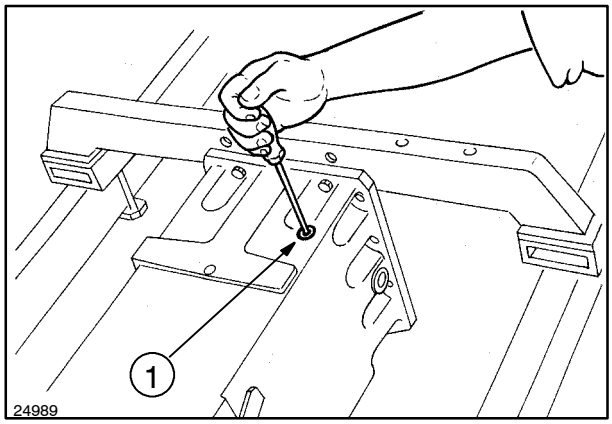
4

2. Take off the retaining pin, remove the relay rod (2) and the internal lever (1).



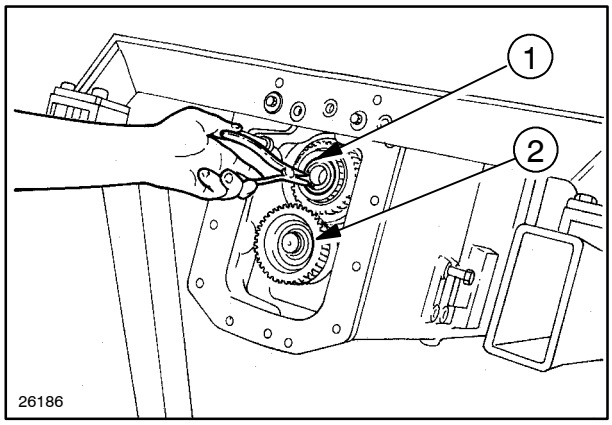
5

3. Take out the grub screw (1), remove the spring and poppet ball.



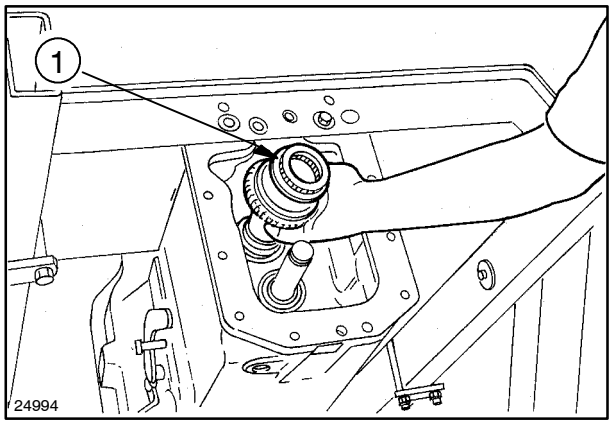
6

4. Take off the circlip (1) and remove the bearing and thrust washers.
   The synchroniser unit together with the control fork and rod.
   The reverser driven gear (2) with its needle bearings and spacer.



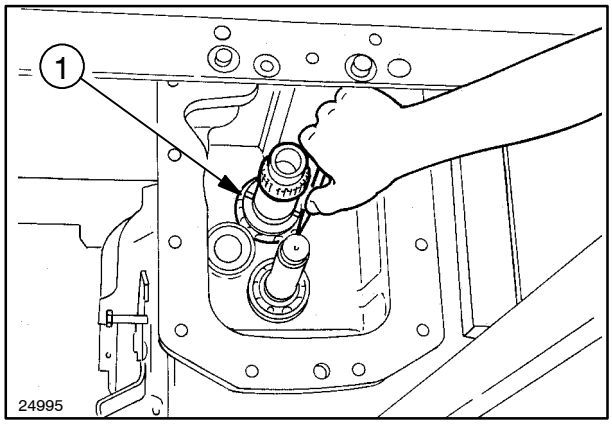
7

5. Extract the reverser driving gear (1) and needle bearings.



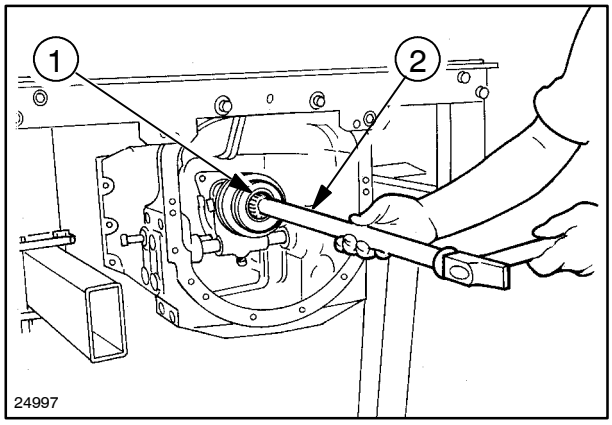
8

6. Remove the circlip (1) retaining the bearing and fixing the reverser driving shaft.



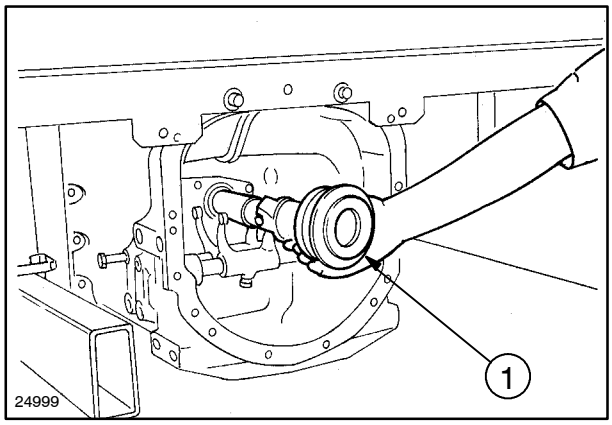
9

7. Operating from the front of the clutch-reverser casing and using an aluminium punch (2), remove the reverser driving shaft (1) from the rear of the casing.



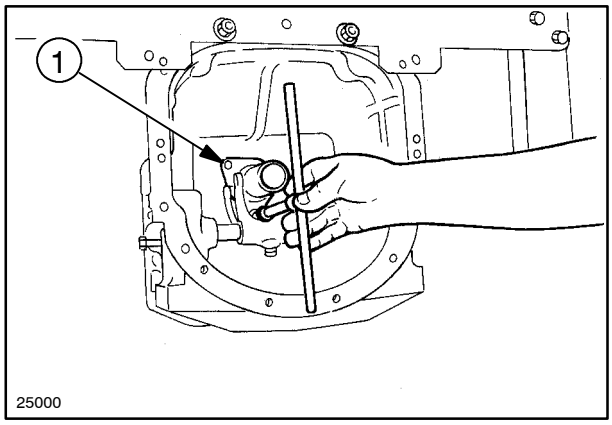
10

8. Release the retaining clips and extract the sliding sleeves (1).



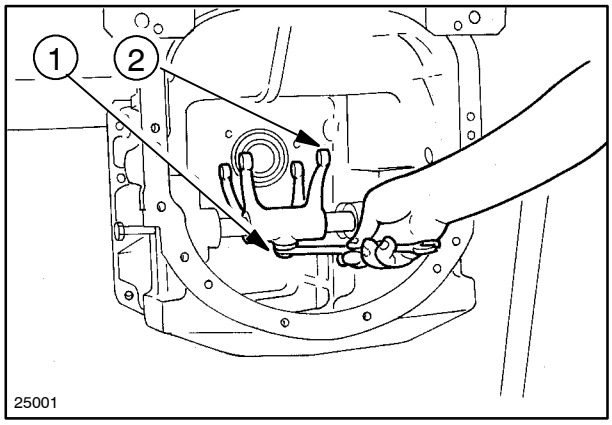
11

9. Remove the nuts and washers then remove the sleeve support cover (1).



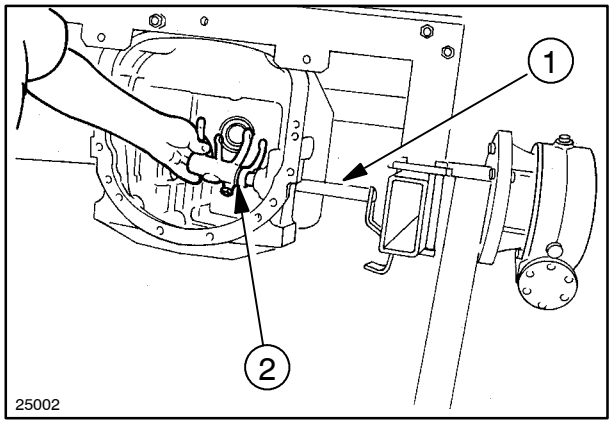
12

10. Take out the two bolts (1) retaining the sliding sleeve forks (2).



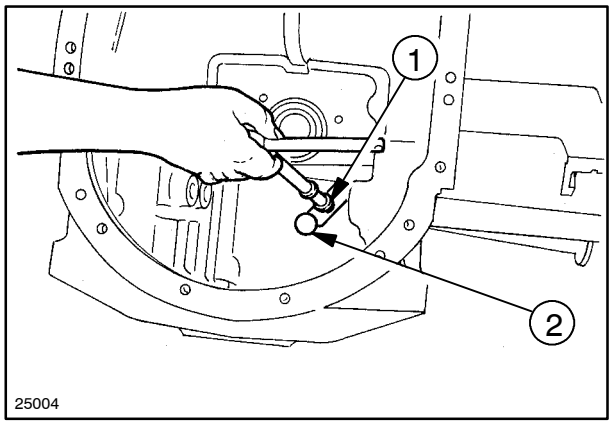
13

11. Extract the two clutch external levers (1) and remove the relative forks (2).



14

12. Straighten out the notching, remove the bolt (1) retaining the reverser driven shaft pin locking plate (2) and the intermediate gear pin, extracting the parts from the rear of the casing.



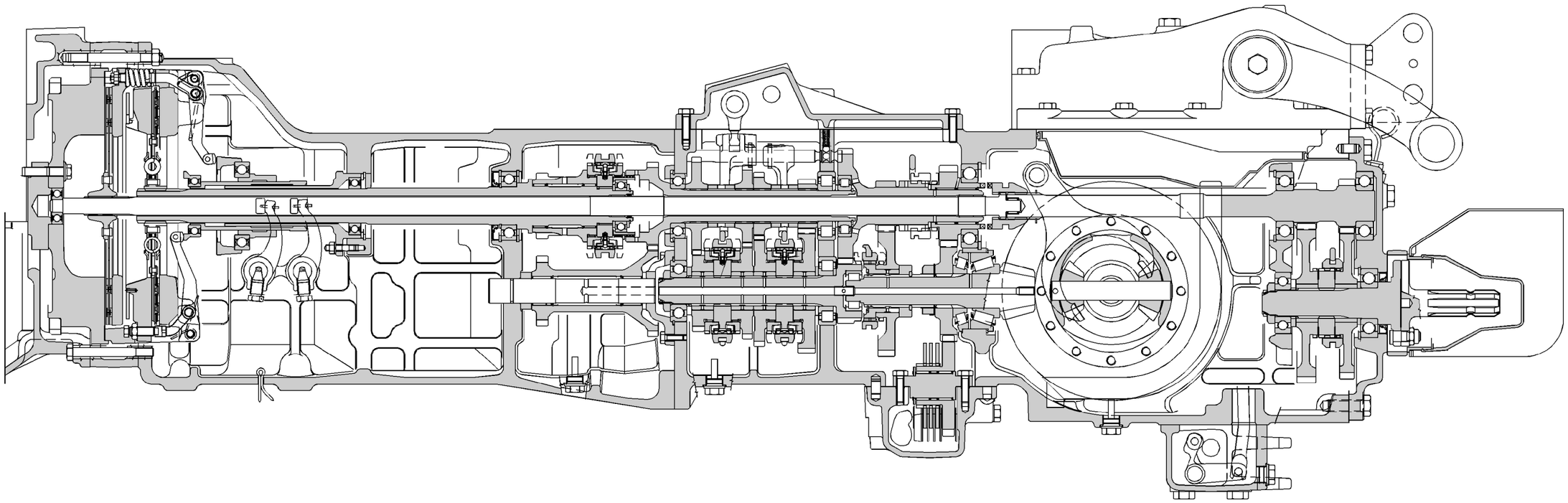
15

13. To refit the reverser proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

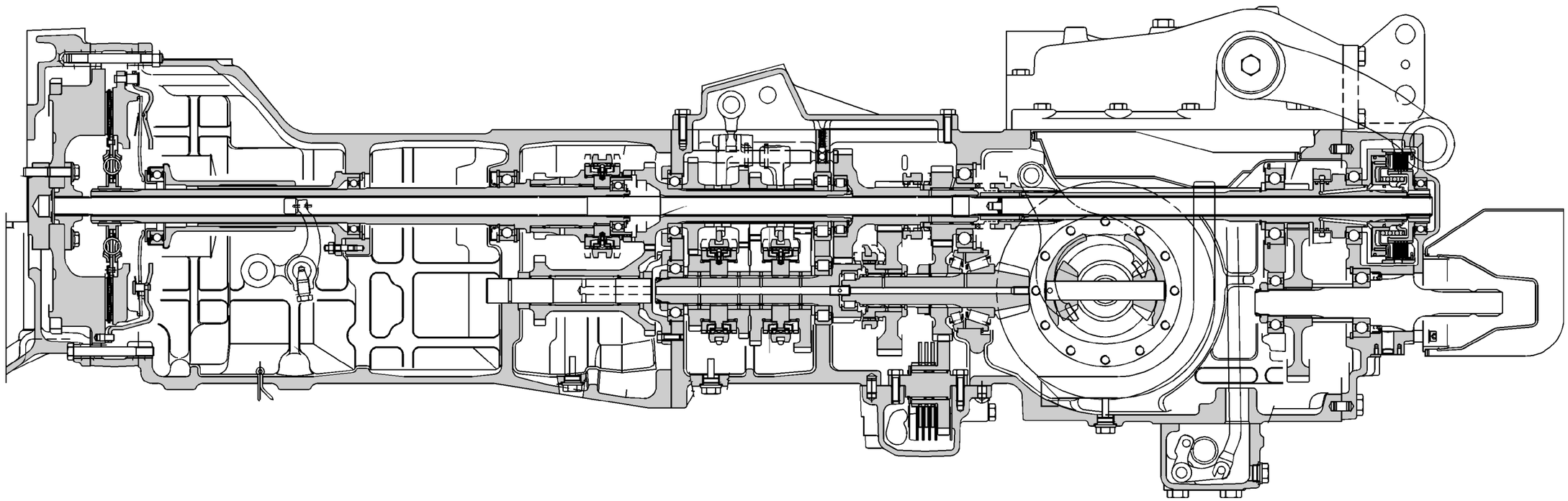
- Study the illustrations in figs. 2 and 3 for the positioning of the various parts.
- Respect the tightening torques prescribed on page 3.
- Fit the intermediate gear pin, complete with all parts, and the reverse driven gear pin and secure with the plate and bolt.
- Fit the sliding sleeve forks on the clutch levers and secure with the bolts.
- Fit the sliding sleeve support cover and secure with the nuts.
- Assemble the sliding sleeves unit on the support and secure to the fork with the clips.
- Working from the rear of the clutch-reverser casing, fit the reverser driving shaft and secure to the casing with the support bearing snap ring.
- Fit the reverser driving gear and bearings on the driving shaft.
- Fit the reverser driven gear and bearings on the driven shaft.
- Assemble the synchroniser unit (control forks, rods, thrust washers and bearing) and insert the relative snap ring.
- Fit the poppet ball, spring and bolt smeared with one of the sealing compounds listed in **Section 00**.
- Position the internal lever, insert the drive lever and secure with the relative circlip.
- Detach the clutch-reverser casing from stand **380000301**.



26188

Longitudinal section of transmission with reverser, dual disk clutch and mechanical PTO.

16



17

Longitudinal section of transmission with reverser, single disk clutch and electro-hydraulic PTO.

SECTION 21 - TRANSMISSIONS

Chapter 3 - OVER DRIVE Unit

CONTENTS

Operation	Description	Page
	OVER DRIVE transmission data	1
	Tightening Torques	2
	Tools	3
	Cross-sectional views	3
	Description and Operation	5
	Fault diagnosis	5
21 110 10	OVER DRIVE Unit R.I.	6
21 110 87	OVER DRIVE Casing - Replacement	7

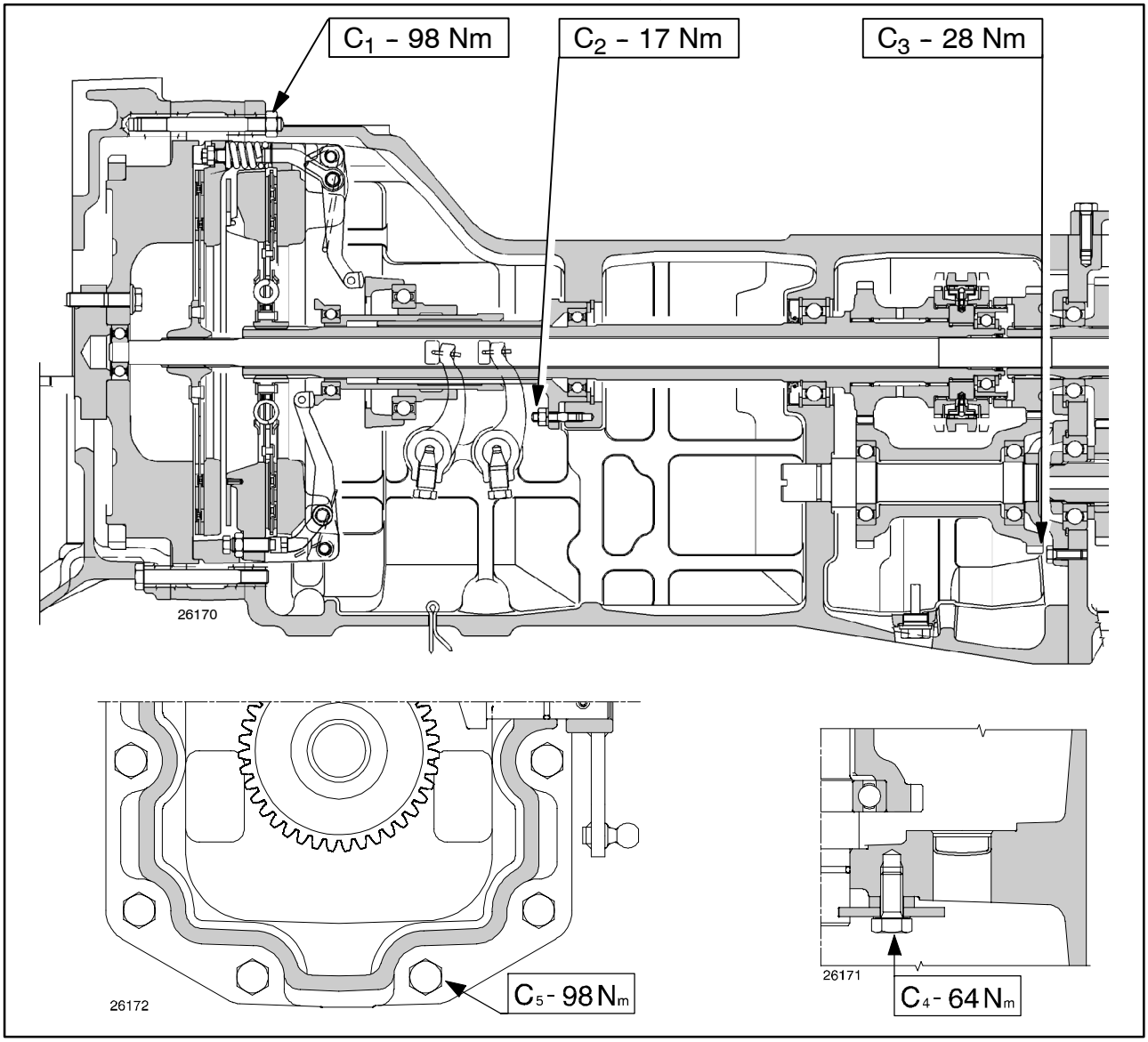
OVER DRIVE DATA

Type	mechanical, ordinary gear train with helical gears, located between the main clutch and gearbox
Operating	with hand lever located on left-hand side of the operator
Coupler	with synchroniser inside the unit

TRANSMISSION DATA

Gearbox	4 speed, constant-mesh, with synchronisers on all gears
Gearing type	helical
Reducer	ordinary gear train with 3 forward gears and 1 reverse gear, making a total of 12 forward and 4 reverse gears
Gearing type	spur
Gearbox and range gear operating system	independent, by means of two hand levers located on the right-hand side of the operator
For missing data see Chapter 1	

TIGHTENING TORQUES



1

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Bolts or nuts securing the clutch - OVER DRIVE unit casing to the engine (C_1)	M 12 x 1.25	98	10
Sleeve cover nuts (C_2)	M 8 x 1.25	17	1,7
OVER DRIVE unit driven shaft support cover retaining bolts (C_3)	M 8 x 1.25	28	2,9
OVER DRIVE driven shaft plate retaining bolt (C_4)	M 10 x 1.25	64	6,5
OVER DRIVE unit clutch casing/gearbox-rear transmission casing retaining bolt (C_5)	M 12 x 1.25	98	10

TOOLS

WARNING

The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

380000236 Tractor disassembly trolley.

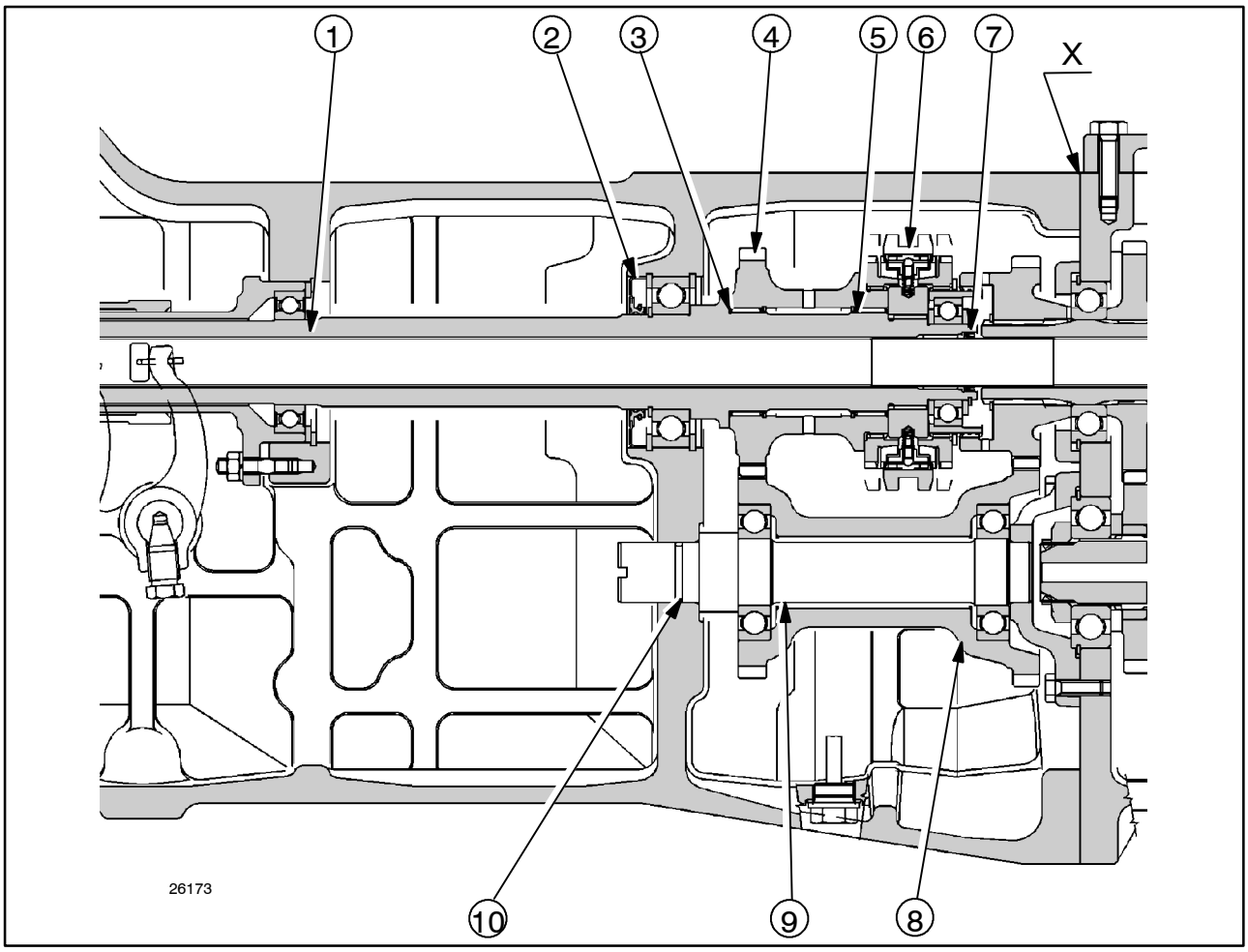
380000227 OVER DRIVE unit-clutch casing lift hook.

380000301 Rotating stand for overhaul operations.

380000271 Front bracket (with **380000301**).

380000272 Rear bracket (with **380000301**).

50006 Adapter to dismantle driven and driving gears (see Sect. 27).

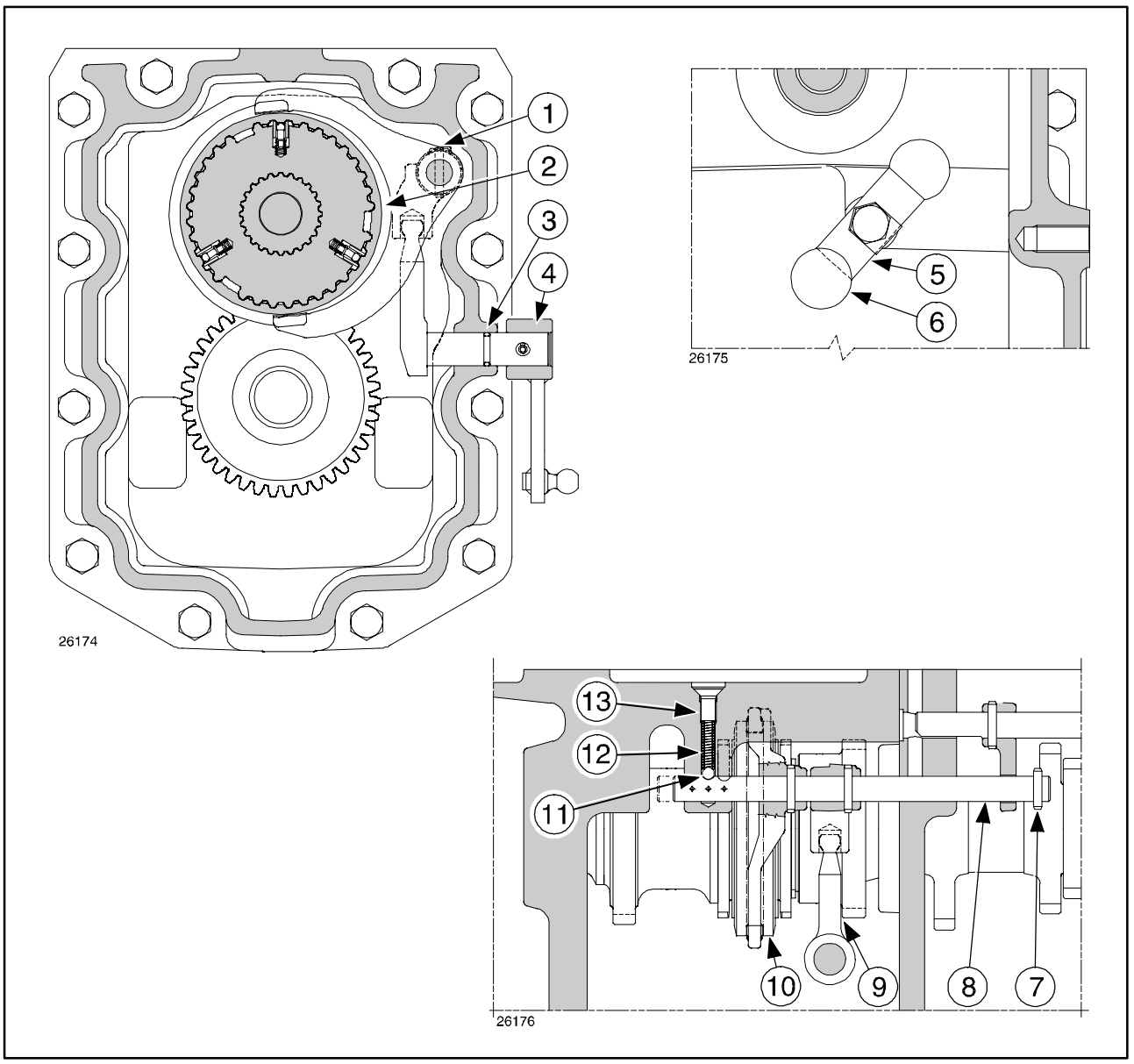


2

Longitudinal cross-sectional view of OVER DRIVE unit

1. OVER DRIVE unit drive shaft.
2. Seal.
3. Needle bearing.
4. OVER DRIVE driving gear.
5. Needle bearing.
6. OVER DRIVE control synchroniser.
7. Seal.
8. OVER DRIVE driven gear.
9. Driven gear pin (8).
10. Seal

NOTE: *On assembly apply a bead of sealing compound to the surfaces **X** as indicated on page 26, chap. .4.*



3

OVER DRIVE cross-sectional views

1. OVER DRIVE control fork.
2. OVER DRIVE control synchroniser.
3. Seal.
4. OVER DRIVE external control lever.
5. Stop plate for journal (6).
6. OVER DRIVE driven gear pin.
7. Retaining pin.
8. OVER DRIVE control rod.
9. OVER DRIVE internal control lever.
10. OVER DRIVE control synchroniser.
11. Poppet ball.
12. Spring for ball (11).
13. Poppet ball retaining screw (the screw must be smeared with one of the sealing compounds listed on page 1, Sect. 00).

DESCRIPTION AND OPERATION

The OVER DRIVE is a step-up device making it possible to increase the tractor speed in the medium, fast and reverse gear ranges, in order to obtain 20 forward gears and 8 reverse gears.

The OVER DRIVE is composed of a train of three cascading helical gears. It is engaged by a synchroniser in the unit and is governed by a lever on the platform to the left of the operator.

The OVER DRIVE unit is installed inside the clutch casing, between the clutch and the gearbox.

Lubrication is by means of the oil in the rear transmission/gearbox.

OVER DRIVE UNIT TROUBLESHOOTING

Problems	Possible Causes	Solutions
OVER DRIVE unit spontaneous disengagement	**1.** External levers and relay rods incorrectly adjusted.	Adjust correctly.
	2. Synchroniser teeth damaged.	Remove the clutch casing-gearbox and replace the synchroniser.
	3. Engagement stroke incomplete.	Eliminate the cause and reset the complete stroke.
Difficulty in engaging the OVER DRIVE unit	**1.** External levers and relay rods incorrectly adjusted.	Adjust correctly.
	2. Stiffness and/or seizure of external levers and rods.	Check rod pivots and lubricate.
	3. Main clutch dragging.	See page 5, Sect. 18.
	4. Synchroniser damaged.	Remove the clutch casing-gearbox and replace the synchroniser.
	5. Internal controls do not slide easily: rods, forks and sleeves.	Overhaul the controls.

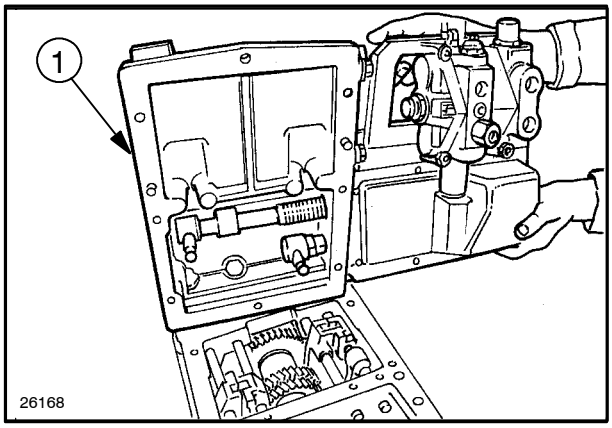
Op. 21 110 10
OVER DRIVE UNIT R.I.

DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

1. To detach the OVER DRIVE unit-clutch casing, it is necessary to remove the cab and the casing, following the directions of sect. 27, in Sect. 90 and in chap. 4, Sect. 21, carrying out the following operations to be able to remove the above-mentioned casing.

2. Take out the retaining bolts and remove the cover (1).



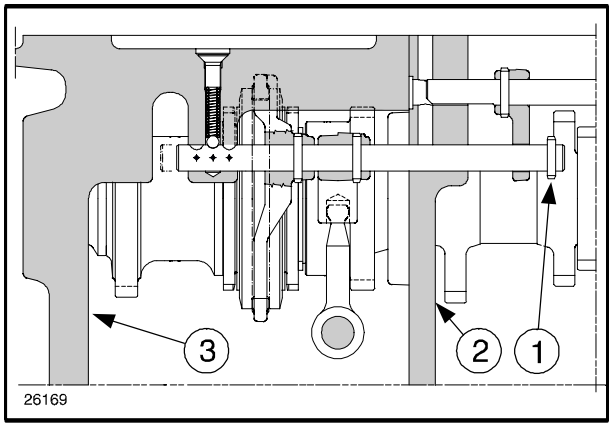
4

3. Extract the retaining pin (1); this will permit separating the OVER DRIVE unit-clutch casing (3) from the gearbox-rear transmission casing (2).
4. To refit the OVER DRIVE, take note of the following.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Respect the tightening torque values prescribed on page 2.
- Refit the components in the reverse order to the removal operations described above.



5

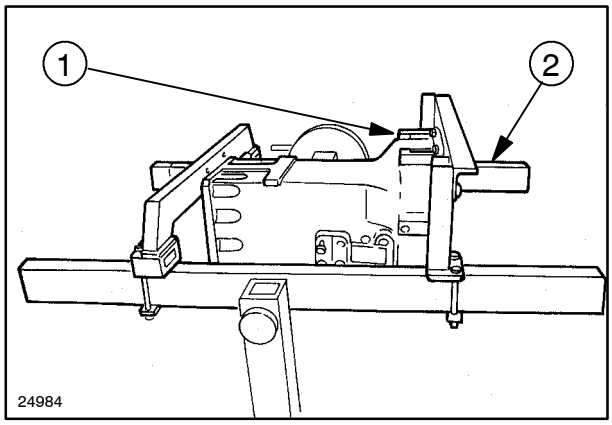
Op. 21 110 87
OVER DRIVE CASING Replacement

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

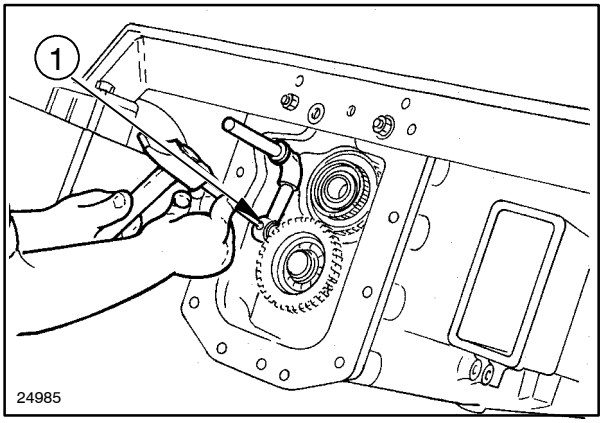
With the clutch casing removed, proceed as follows.

1. Secure the OVER DRIVE casing (1) on the rotating stand **380000301** (2) using the two brackets **380000271** and **380000272**.



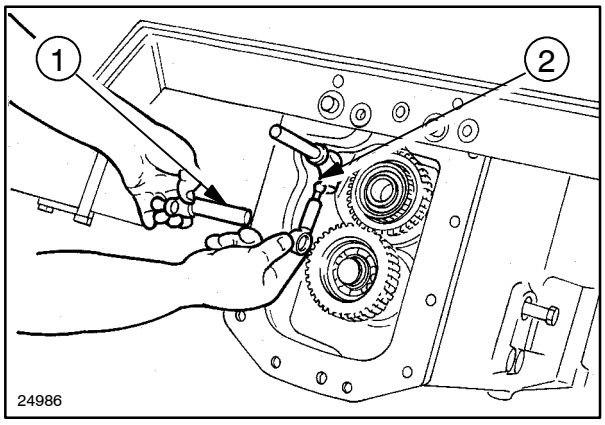
6

2. Take out the pin (1) securing the relay rod to the internal lever.



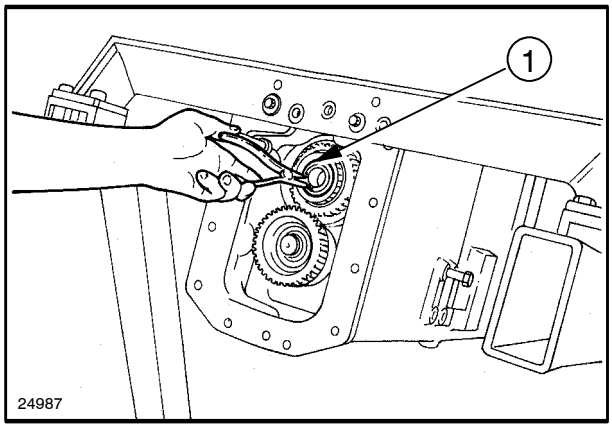
7

3. Remove the relay rod (1) and the internal lever (2).



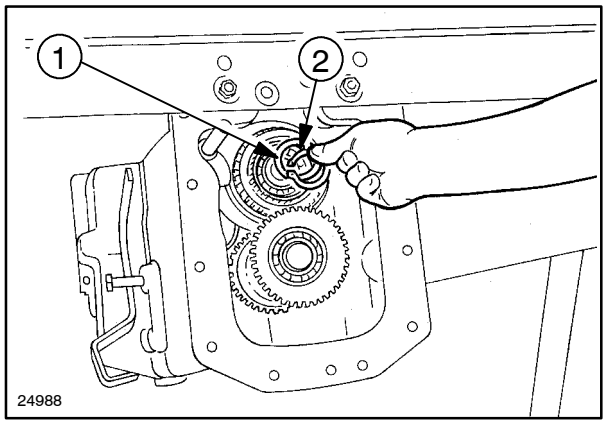
8

4. Remove the circlip (1) from the OVER DRIVE driving shaft.



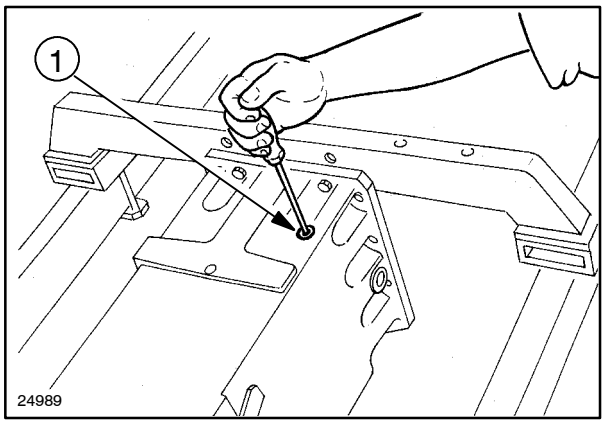
9

5. Remove the circlip (2) and the thrust washer (1).



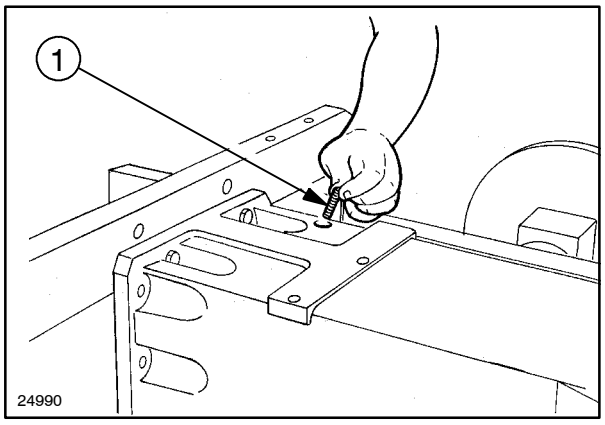
10

6. Take out the screw (1) retaining the spring for the poppet ball.



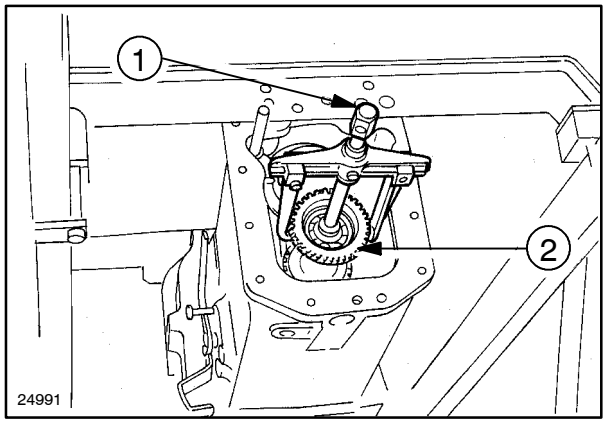
11

7. Remove the spring (1) and the poppet ball.



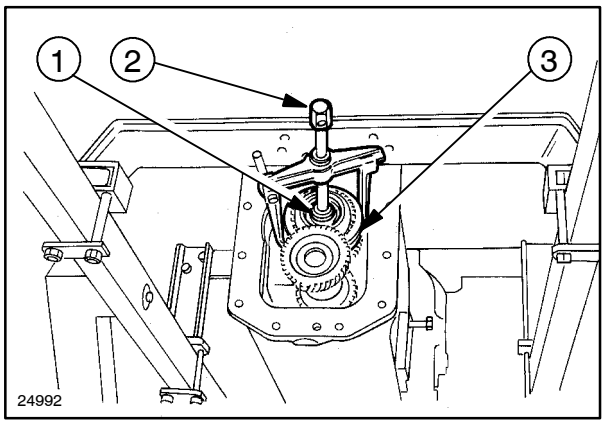
12

8. Using a universal puller (1) hooked onto the external gear (2) of the driven shaft, extract the gear to free it for subsequent disassembly.



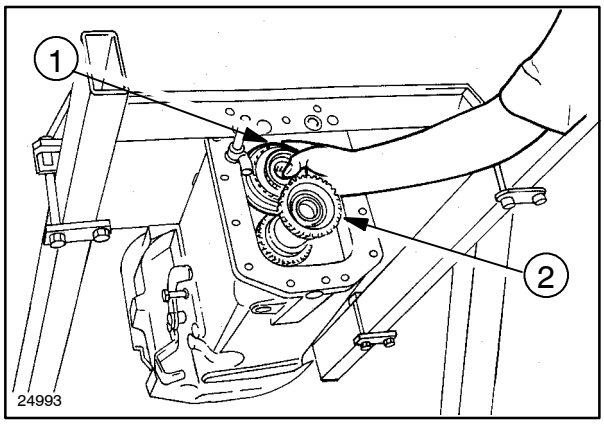
13

9. Position tool **50006** (1, see Sect. 27) on the end of the driving shaft and, using the universal puller (2), extract the complete synchroniser unit (3) and the bearing.



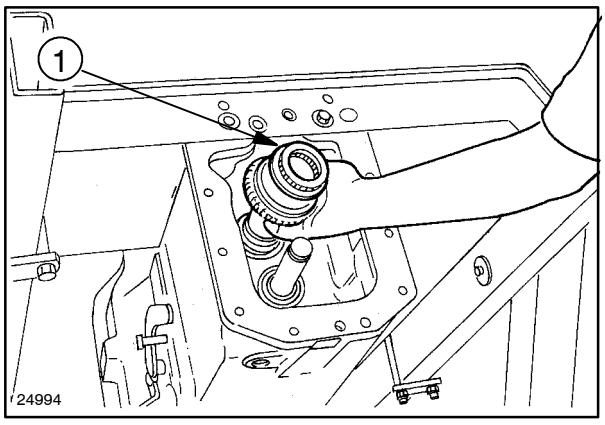
14

10. Remove the synchroniser unit (1), the fork with its rod and the driven gear (2).



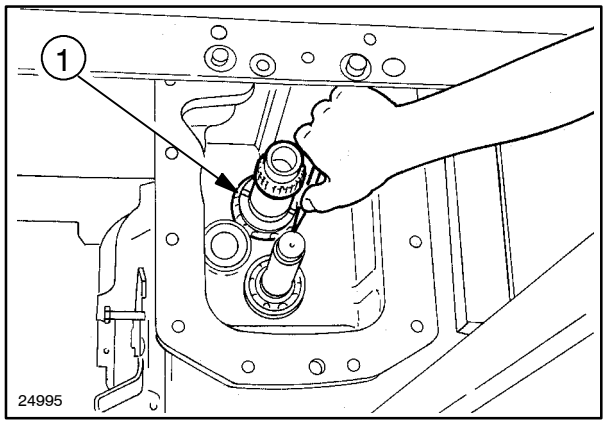
15

11. Take the relevant gear (1) and the needle bearings off the driving shaft.



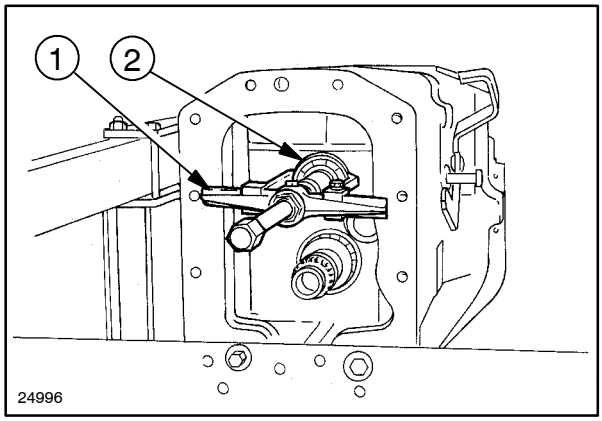
16

12. Remove the circlip (1) retaining the OVER DRIVE driving shaft.



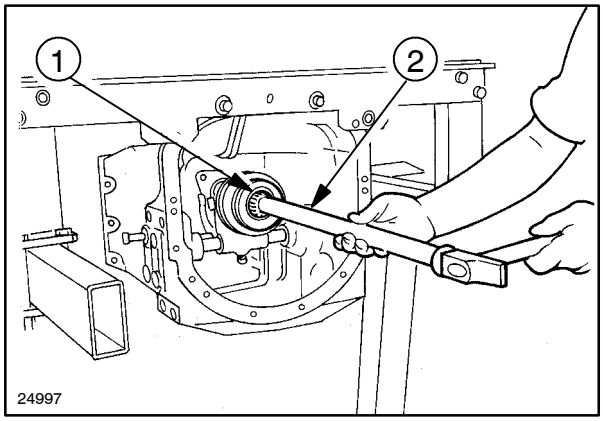
17

13. Using a universal puller (1), remove the internal bearing (2) force-fitted on the driven shaft.



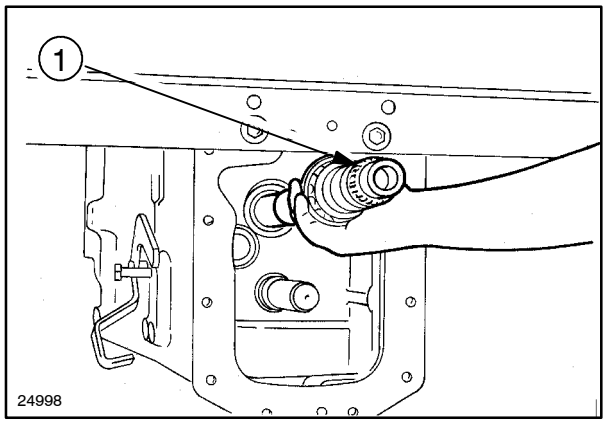
18

14. Release the driving shaft (1) from the front with the aid of a hammer and the aluminium punch (2).



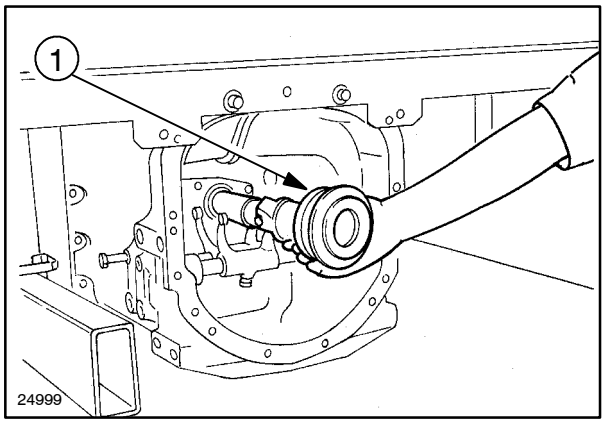
19

15. Remove the driving shaft (1) from the rear.



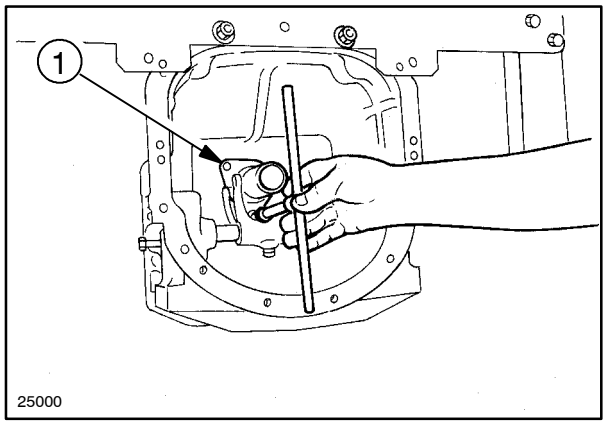
20

16. Remove the retaining clips and the thrust bearing sleeves (1).



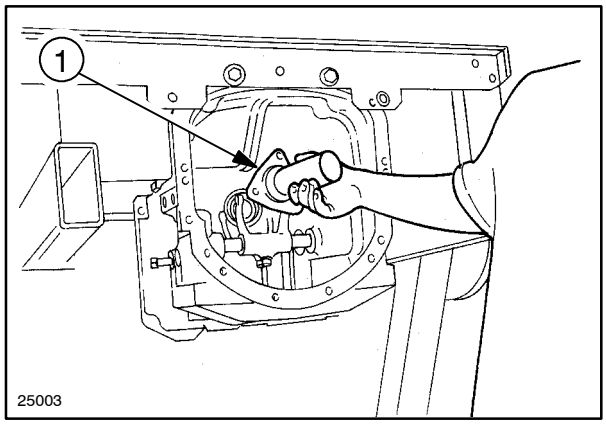
21

17. Unscrew the three screws (1) retaining the sleeve support cover.



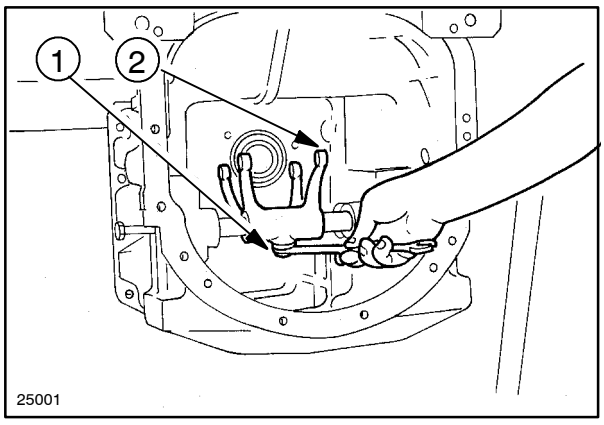
22

18. Remove the sleeve support cover (1).



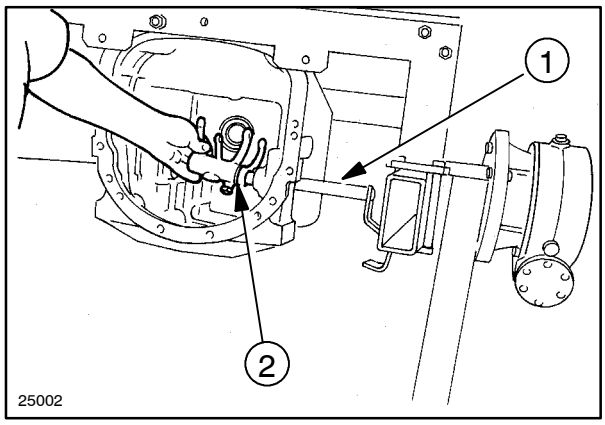
23

19. Unscrew the two bolts (1) securing the thrust bearing sleeve control forks (2).



24

20. Extract the clutch levers (1) and remove the forks (2).

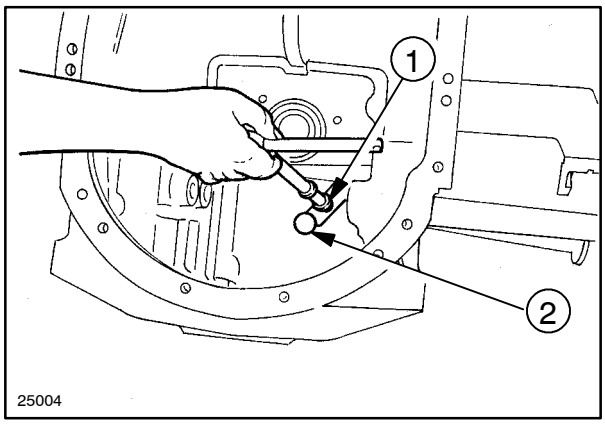


25

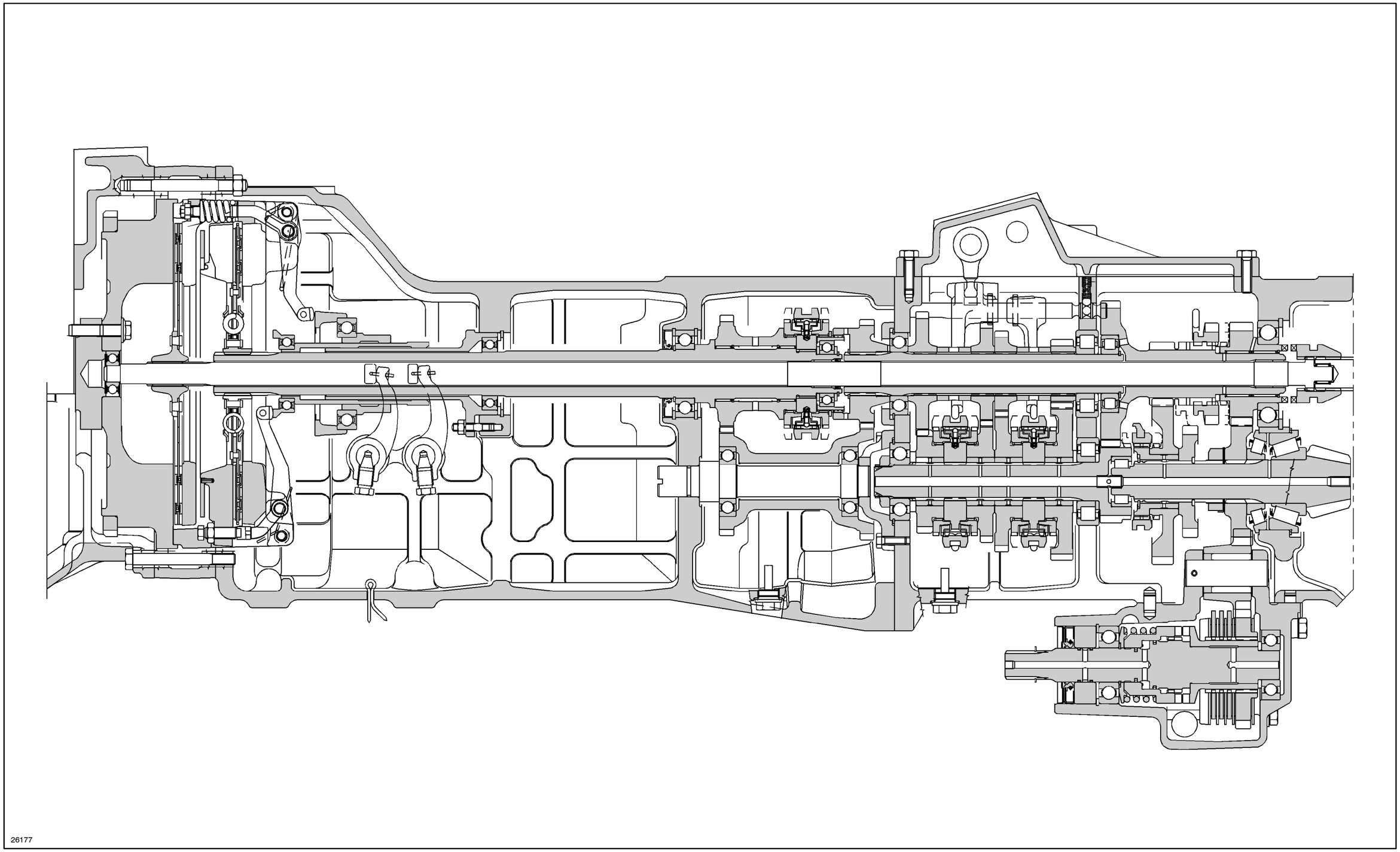
21. Straighten out the stop plate, unscrew the screw (1) locking the driven shaft (2) and remove the shaft from the rear of the casing.

22. Install the OVER DRIVE unit, taking note of the following.

    - Refer to the illustrations on pages 3 and 4 for the positioning of the various parts.
    - Respect the tightening torque values prescribed on page 2.
    - Install the driven shaft, securing it with the relevant screw. Notch the stop plate back on the screw.
    - Fit the sleeve support cover. Insert the clutch levers and mount the forks on these.
    - Fit the gear with the internal bearing on the driven shaft. At the same time, fit the needle bearings and the gear on the driving shaft.
    - Insert the internal fifth wheel, the synchroniser unit and the control fork together with the relevant rod.
    - Fit the external bearing on the driven gear, insert the external thrust washer on the driving shaft and lock the unit with the circlip.
    - Insert the poppet ball and spring, then lock the screw after smearing it with sealant.
    - Fit the internal and external levers controlling the fork. Lock both of them with the relevant pin.
    - Mount the clutch thrust bearing sleeves, securing them with the clips.



26



26177

Longitudinal cross-sectional view of OVER DRIVE unit

27

SECTION 21 - TRANSMISSIONS

Chapter 4 - Dual Command (2 Speed Power Shift)

CONTENTS

Operation	Description	Page
	Data	2
	Tightening Torques	4
	Tools	5
	Cross-sectional views	6
	Description and Operation	10
	Fault diagnosis	16
21 110 10	Clutch casing with Dual Command (2 Speed Power Shift) R.I.	18
21 110 87	Clutch casing with Dual Command (2 Speed Power Shift) D.A.	27
21 168 05	Dual Command (2 Speed Power Shift) linkage adjustment	36
21 168 21	Dual Command (2 Speed Power Shift) solenoid valve R.I.	37
21 168 22	Dual Command (2 Speed Power Shift) control valve R.I.	41
21 168 23	Dual Command (2 Speed Power Shift) control valve D.A.	45

DATA

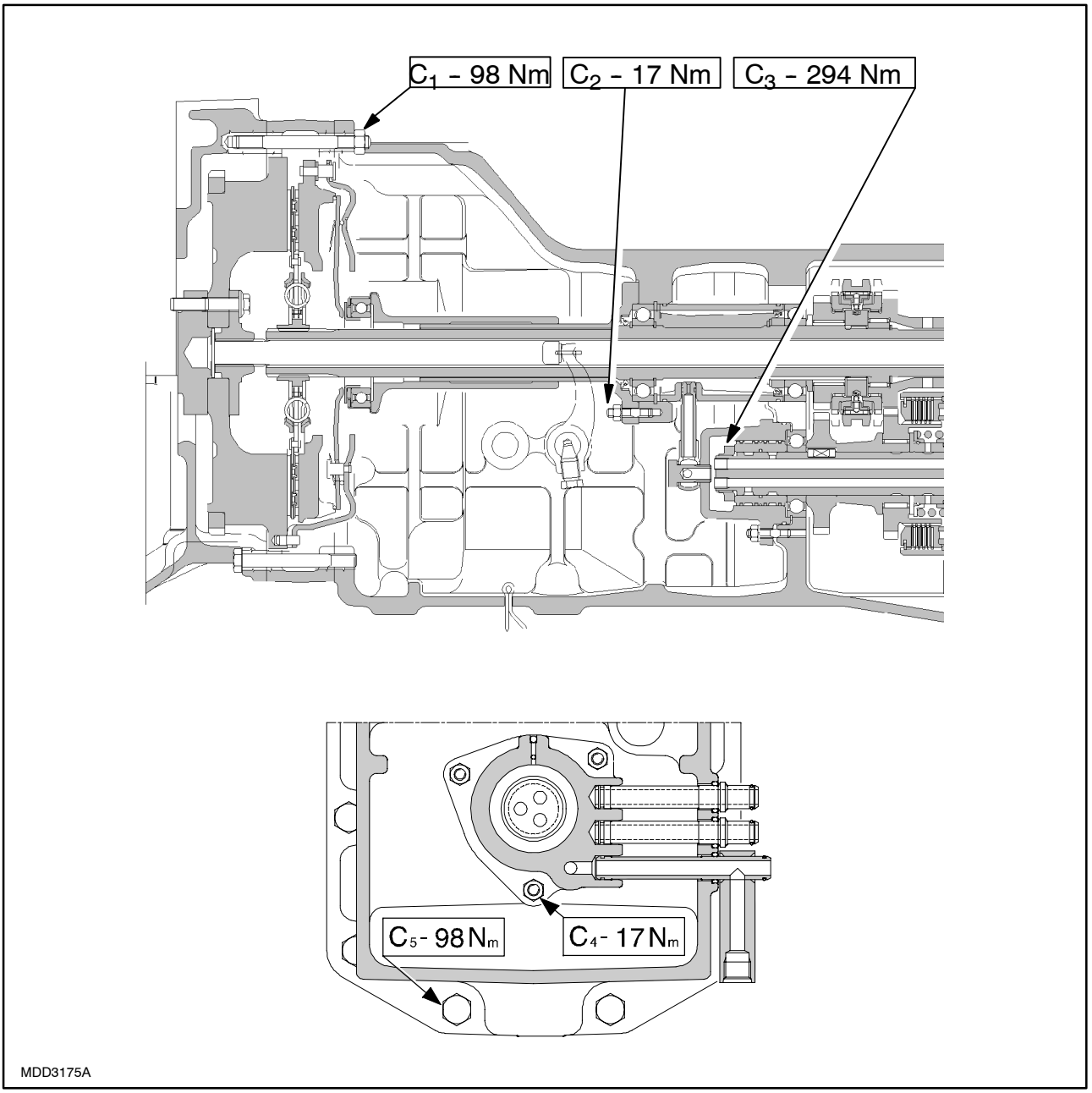
Gearbox		4 speed, constant-mesh, with synchronisers on all gears
Gearing type		helical
Reducer		Ordinary gear train with 3 ranges providing a total of 12 gears
Gearing type		spur
Gearbox and range gear operating system		independent, by means of two hand levers located on the right-hand side of the operator
Reverser		mechanical type, located between the engine clutch and the gearbox. Composed of no. 1 driving gear, no. 1 intermediate gear and no. 1 intermediate gear.
Operating system		with hand lever located on left-hand side of the operator
Dual Command (2 Speed Power Shift)		provides two speeds (HIGH and LOW) within the same gear. The two speeds can be engaged under load by means of two multi-disk clutches in oil baths.
Operating		by means of the cursor located on the gearshift lever
Number of driven plates in each Dual Command (2 Speed Power Shift) clutch (see fig. 2)	no.	5
Driven plate thickness	in. (mm)	0.0688 to 0.0728 (1.75 to 1.85)
Driven plate material		steel
Number of driving plates in each Dual Command (2 Speed Power Shift) clutch	no.	5
Thickness of driving plates	in. (mm)	0.0767 to 0.0807 (1.95 to 2.05)
Driving disk face material		clutch
Springs (11 and 17, fig. 2) Dual Command (2 Speed Power Shift) clutch piston return:		
- length of free springs	in. (mm)	2.4015 (61)
- length of springs under load of 954 to 1052 N (97.3 to 107.3 kg)	in. (mm)	1.3385 (34)
Thickness of adjustment rings (3, fig. 2) driving shaft clearance	in. (mm)	0.0393 - 0.0413 - 0.0433 - 0.0452 - 0.0472 - 0.0551 - 0.0590 - 0.0669 - 0.0688 - 0.0708 - 0.0728 - 0.0748 - 0.0767 - 0.0787 - 0.0826 - 0.0846 - 0.0866 - 0.0885 - 0.0905 - 0.0925 - 0.0944 - 0.0964 - 0.0984 - 0.1003 - 0.1023 - 0.1043 - 0.1062 - 0.1082 - 0.1102 - 0.1122 - 0.1141 - 0.1161 - 0.1181 - 0.1200 - 0.1220 - 0.1240 - 0.1259 - 0.1279 - 0.1299 - 0.1318 - 0.1338 - 0.1358 - 0.1377 - (1 - 1.05 - 1.1 - 1.15 - 1.2 - 1.4 - 1.5 - 1.7 - 1.75 - 1.8 - 1.85 - 1.9 - 1.95 - 2 - 2.05 - 2.1 - 2.15 - 2.2 - 2.25 - 2.3 - 2.35 - 2.4 - 2.45 - 2.5 - 2.55 - 2.6 - 2.65 - 2.7 - 2.75 - 2.8 - 2.85 - 2.9 - 2.95 - 3 - 3.05 - 3.1 - 3.15 - 3.2 - 3.25 - 3.3 - 3.35 - 3.4 - 3.45 - 3.5)

(continued)

DATA

(cont)

Hydraulic control valve (see fig. 4)		mounted on the outer left-hand side of the clutch casing and includes: - solenoid valve; - pressure control valve; - no. 2 accumulators; - no. 2 chokes on accumulators; - pressure release pin; - by-pass valve.
Mating clearance between:		
- pressure control valve (16, fig. 4) and hydraulic control valve seat	in. (mm)	0.0009 to 0.0013 (0.025 to 0.035)
- pressure release pin (15) and relative hydraulic control valve seat	in. (mm)	0.0009 to 0.0013 (0.025 to 0.035)
- accumulator pistons (3) and hydraulic control valve seat	in. (mm)	0.0009 to 0.0005 (0.025 to 0.080)
Dual Command (2 Speed Power Shift) and services working pressure	psi (bar)	227.72 to 242.22 (15.7 to 16.7)
Spring (17, fig. 4) for pressure control valve:		
- spring free length	in. (mm)	5 (127)
- spring length under load of 279 to 304 N (28.4 to 31 kg)	in. (mm)	4.035 (102,5)
Spring (10) for pressure release pin:		
- spring free length	in. (mm)	3.070 (78)
- spring length under load of 32 to 36 N (3.3 to 3.7 kg)	in. (mm)	2.6771 (68)
Springs (4) for accumulators:		
- spring free length	in. (mm)	4.8031 (122)
- spring length under load of 325 to 359 N (33.2 to 36.6 kg)	in. (mm)	3.9370 (100)
Filter		
Type		paper cartridge
Location		fixed to the pump housing on suction side
Pump		the same as used for the hydrostatic steering system (see Section 41, pages 3-4)



1

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Bolts or nuts securing the clutch casing to the engine (C_1)	M 12 x 1.25	98	10
Nuts for sleeve cover studs (C_2)	M 8 x 1.25	17	1,7
Driven shaft lock nut (C_3)	M 32 x 1.5	294	30
Nuts (C_4) for driven shaft manifold cover studs	M 8 x 1.25	17	1,7
Bolts securing the clutch casing to the transmission casing (C_5)	M 12 x 1.25	98	10
Solenoid valve retaining nut (C_1, fig. 4)	-	5.4 to 8.1	0.55 to 0.83
Solenoid valve pin retaining bolt (C_2, fig. 4)	-	47 to 54	4.8 to 5.5

TOOLS

WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**.

To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

380000301 Rotating stand for overhaul operations.

380000236 Tractor disassembly stand.

380000227 Gear casing lift hook.

380000271 Front bracket for gear overhauls (with **380000301**).

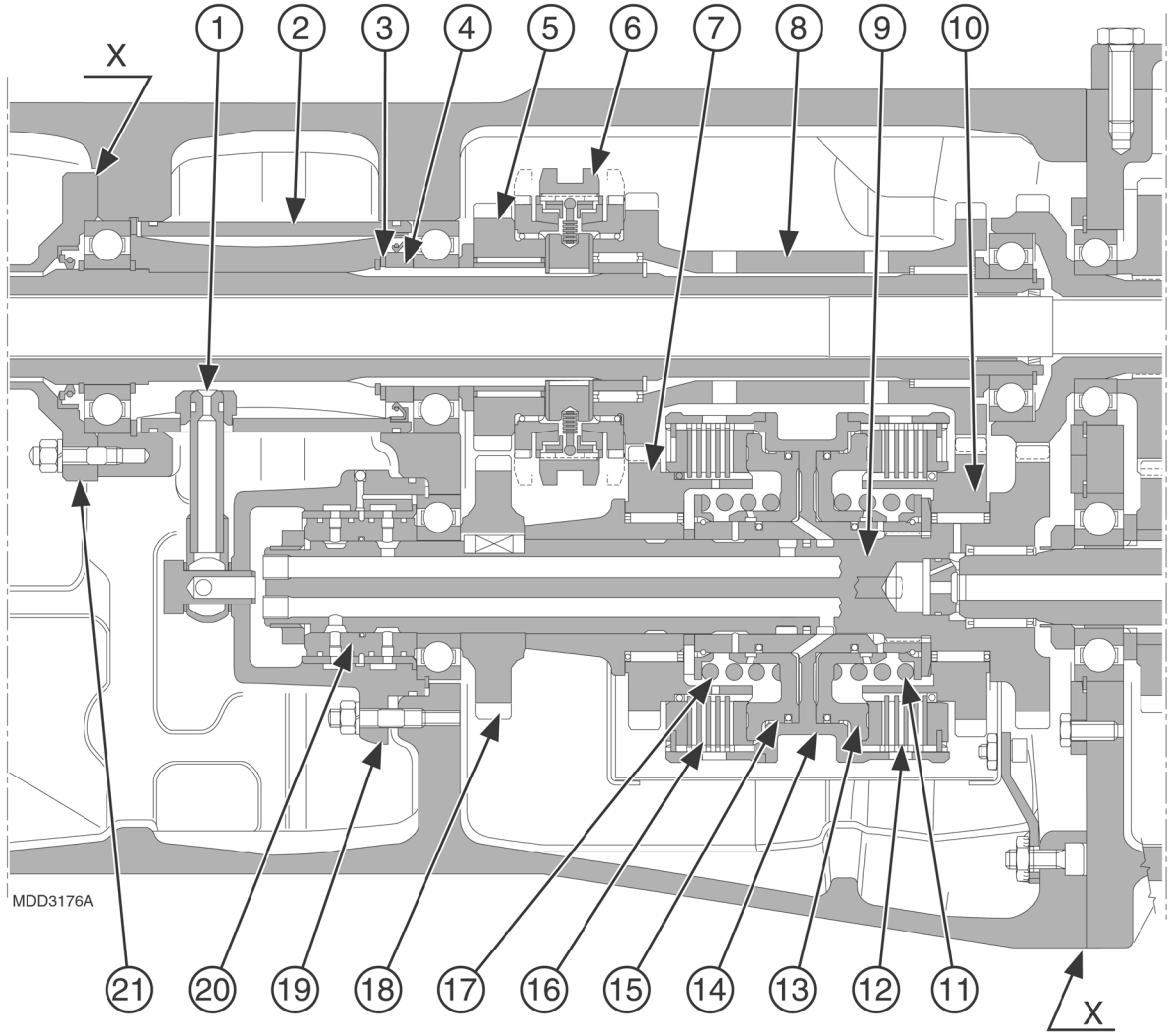
380000272 Rear bracket for gear overhauls (with **380000301**).

380000243 Press for clutch springs.

X 380000244 Driven shaft stop and support.

380000245 Tool for fitting seal on clutch hub.

X 380000240 Pressure check kit.

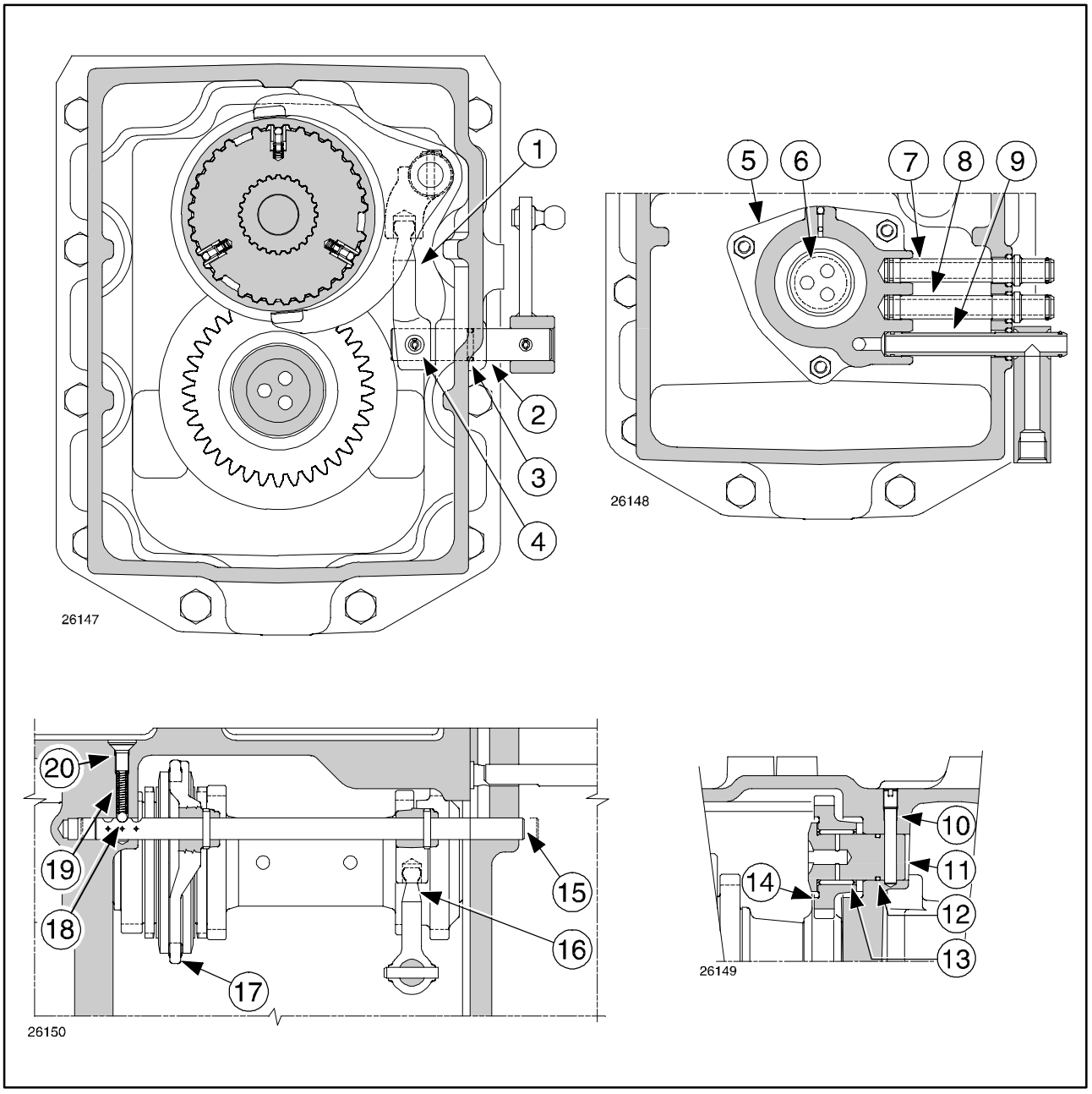


2

Longitudinal view of the Dual Command (2 Speed Power Shift) and reverser 18.64 mph (30 km/h) version)

1. Dual Command (2 Speed Power Shift) and Reverser driving shaft bearing lubrication lines.
2. Spacer.
3. Driving shaft gear unit end float adjustment ring.
4. Bearing spacer.
5. Reverser-reverse gear unit.
6. Reverser synchroniser unit.
7. HIGH gear driving gear.
8. Dual Command (2 Speed Power Shift) driving gear.
9. Driven shaft.
10. LOW clutch driving gear.
11. LOW clutch spring.
12. LOW clutch.
13. LOW clutch control piston.
14. Clutch casing.
15. HIGH clutch control piston.
16. HIGH clutch.
17. HIGH clutch spring.
18. Reverse driven gear.
19. Driven shaft manifold cover.
20. Clutch delivery manifold ring.
21. Cover.

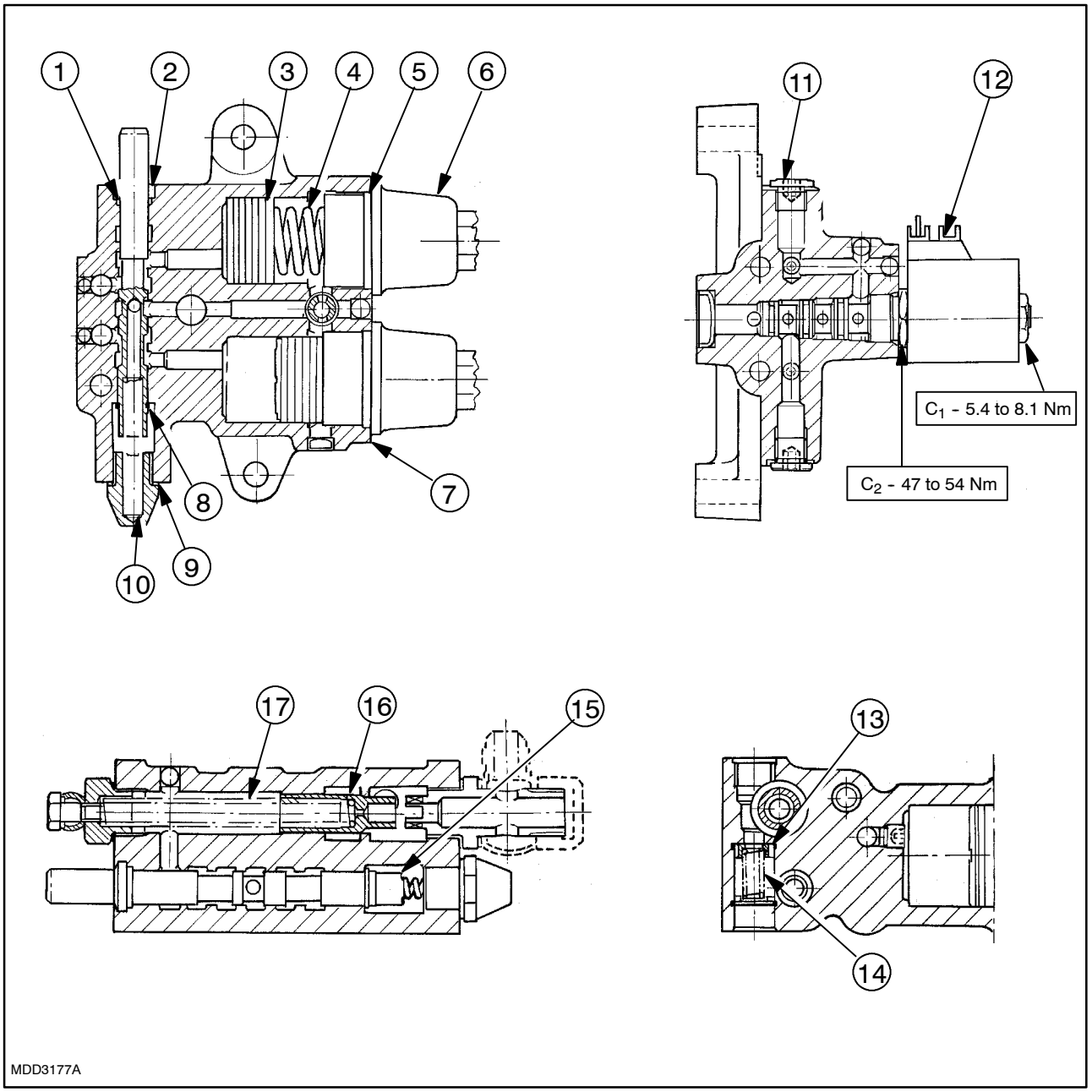
NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *as shown in fig. 35.*



3

Cross-sectional view of the Dual Command (2 Speed Power Shift) and Reverser 18.64 mph (30 km/h) version)

1. Reverser internal control lever.
2. Reverser control lever pin.
3. Seal.
4. Flexible pin.
5. Driven shaft manifold cover.
6. Driven shaft.
7. LOW clutch delivery line.
8. HIGH clutch delivery line.
9. Lubrification pipe.
10. Retaining bolt.
11. Intermediate gear journal.
12. Seal.
13. Needle bearing.
14. Reverser-reverse intermediate gear unit.
15. Reverser control rod.
16. Reverser internal control lever.
17. Reverser control fork.
18. Poppet ball.
19. Spring.
20. Poppet ball retaining screw



4

Cross-sectional view of Dual Command (2 Speed Power Shift) hydraulic control valve

C_1. Solenoid valve retaining nut.
C_2. Solenoid valve pin retaining bolt.
1. Seal.
2. Dust scraper ring.
3. Accumulator piston.
4. Piston return spring (3).
5. Seal.
6. Accumulator cap.
7. Control valve body.
8. Stop ring.
9. Seal.
10. Pin return spring (15).
11. Plug.
12. Dual Command (2 Speed Power Shift) control valve solenoid valve.
13. By-pass valve.
14. By-pass valve spring.
15. Pressure release pin.
16. Pressure control valve.
17. Valve return spring (16).

DESCRIPTION AND OPERATION

The Dual Command (2 Speed Power Shift) is composed of two clutches in oil baths, a control valve (16, fig. 5) commanded by a solenoid valve (15) and the hydraulic pump (24, the same as for the power steering circuit) using oil from the rear transmission-gearbox.

The Dual Command (2 Speed Power Shift) provides two speeds in the forward gear, when the reverse gear is engaged the Dual Command (2 Speed Power Shift) automatically disengages.

The HIGH or LOW speeds are selected by means of the cursor located on the gear shift lever (13).

For the various Dual Command (2 Speed Power Shift) functions see below.

TRACTOR STOP HYDRAULIC DIAGRAM (18.64 MPH /30 KM/H VERSION)

When the clutch pedal (21) is pressed the wire pulls the lever (20), which moves the pressure release pin (19), connecting with the clutch line drainage: in this manner the two clutches are held in the disengaged position by the relative springs.

The oil, coming from the hydraulic pump (24) and regulated on a pressure of 227.72 to 242.22 (15.7 to 16.7 bar) by the valve (14), acts on the piston of the accumulator (18), overcomes the resistance of the spring and fills the accumulator; at this stage all of the oil is in the lubrication circuit.

NOTE: *This description refers to the 18.64 mph (30 km/h) version with HIGH speed inserted; i.e.: the cursor on the gearshift lever (13) must be in position (B).*

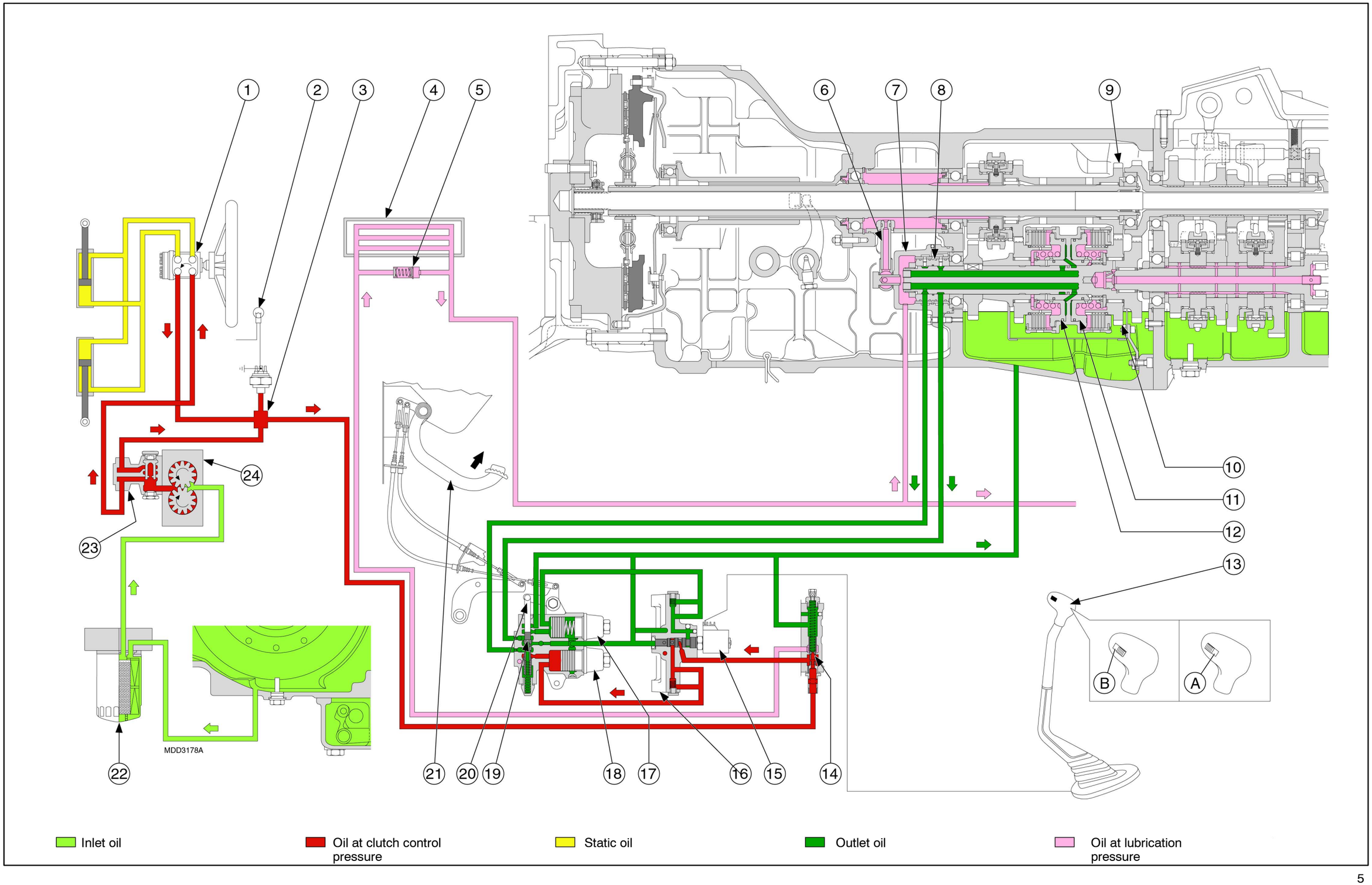
When the cursor is in this position on the 24.85 mph (40 km/h) version, the accumulator (18) is not involved, whereas accumulator (17) is.

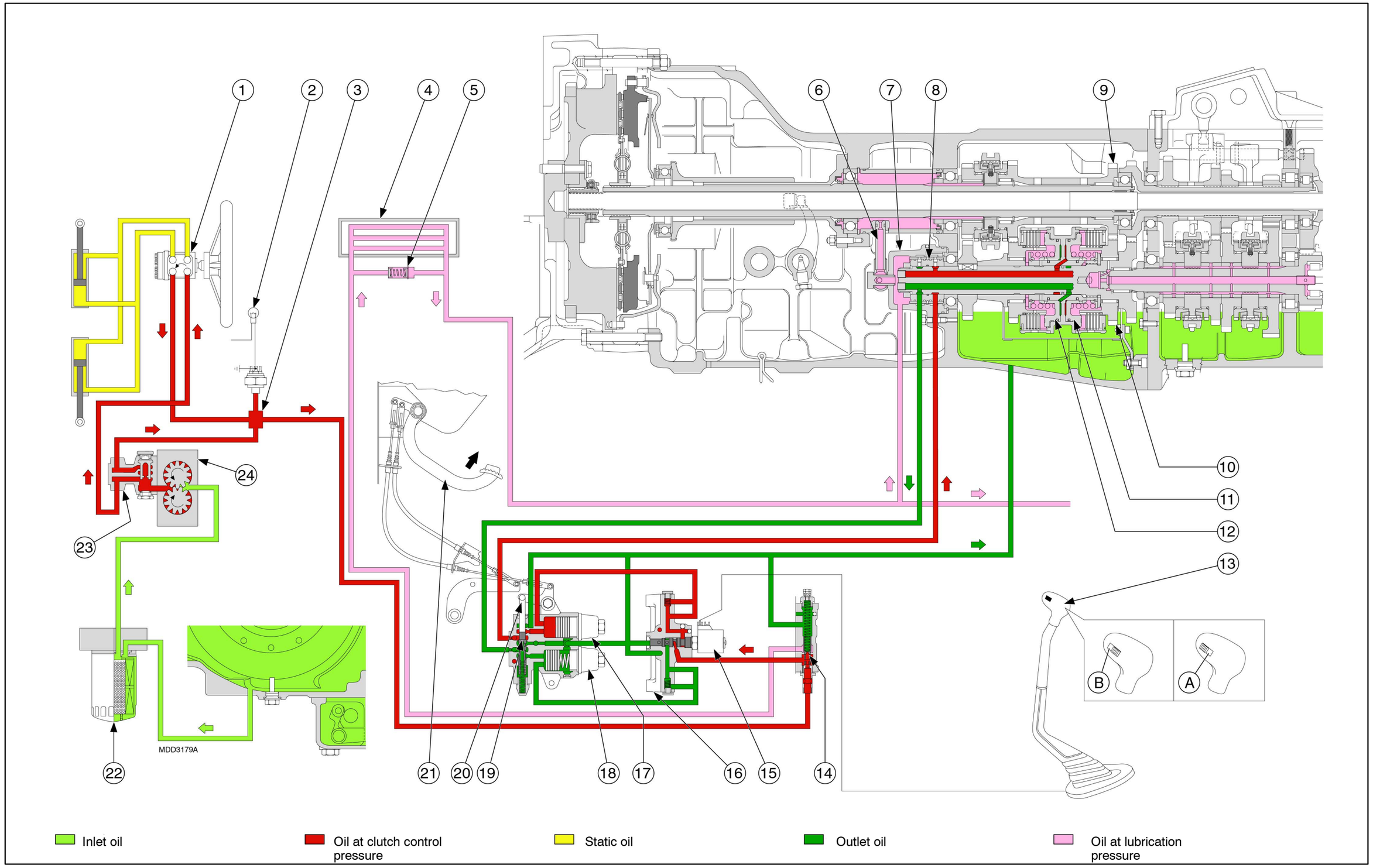
The 24.85 mph (40 km/h) version differs from the 18.64 mph (30 km/h) version because the gear torque (9 and 10) changes the number of teeth and, therefore, also the ratio. The HIGH and LOW clutches, and relative accumulators (18 and 17), reverse functions - i.e.: HIGH becomes LOW, and vice versa.

Tractor stop diagram

1. Power steering control valve.
2. Low oil pressure indicator.
3. Power steering circuit anti-cavitation tank.
4. Cooler.
5. By-pass valve.
6. Driving shaft lubrication lines.
7. Driven shaft manifold cover.
8. Clutch delivery manifold ring.
9. Driving Gear.
10. Driven Gear.
11. LOW clutch piston (18.64 mph (30 km/h) version).
12. HIGH clutch piston (18.64 mph (30 km/h) version).
13. Gearshift lever with Dual Command (2 Speed Power Shift) cursor.
14. Pressure control valve.
15. Dual Command (2 Speed Power Shift) control valve solenoid.
16. Control valve.
17. LOW clutch accumulator (18.64 mph (30 km/h) version).
18. HIGH clutch accumulator (18.64 mph (30 km/h) version).
19. Pressure release pin.
20. Pin lever (19).
21. Clutch pedal.
22. Filter.
23. Flow divider.
24. Hydraulic pump.

NOTE: *On the 24.85 mph (40 km/h) version the HIGH and LOW clutches, and relative accumulators (18 and 17), reverse functions - i.e.: LOW becomes HIGH, and vice versa.*


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
A
B
MDD3178A
Inlet oil
Oil at clutch control pressure
Static oil
Outlet oil
Oil at lubrication pressure


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
A
B
MDD3179A
Inlet oil
Oil at clutch control pressure
Static oil
Outlet oil
Oil at lubrication pressure

LOW CLUTCH ENGAGED HYDRAULIC DIAGRAM (18.64 mph-30 km/h version)

With any forward gear engaged and with the cursor on the gearshift lever (13, fig, 6) in position (A), by releasing clutch pedal (21) the lever (20) releases the clutch discharge pin (19) which, by means of the spring, returns to the neutral position.

The oil, coming from the hydraulic pump (24) and regulated at a pressure of 227.72 to 242.22 psi (15.7 to 16.7 bar) by the valve (14), acts on the accumulator (17), overcomes the resistance of the spring, fills the accumulator and, through the pipe freed by the pin (19), reaches the LOW clutch, acts on the piston (11), overcomes the resistance of the associated spring engaging the LOW speed.

The oil from the pump now keeps the LOW clutch engaged and, through the valve (14), is conveyed into the lubrication circuit.

NOTE: *The aforementioned description refers to the 18.64 mph (30 km/h) version with LOW speed engaged; i.e.: with the cursor on the gearshift lever (13) must be in position (A).*
With the cursor in this position on the 24.85 mph (40 km/h) version, accumulator (17) is not involved whereas accumulator (18) is.
The 24.85 mph (40 km/h) version differs from the 18.64 mph (30 km/h) version only in the pair of gears (9 and 10) that changes the number of teeth and, therefore, also the ratio. The HIGH and LOW clutches, and relative accumulators (18 and 17), reverse functions - i.e.: HIGH becomes LOW, and vice versa.

LOW clutch engaged hydraulic diagram

1. Power steering control valve.
2. Low oil pressure indicator.
3. Power steering circuit anti-cavitation tank.
4. Cooler.
5. By-pass valve.
6. Driving shaft lubrication lines.
7. Driven shaft manifold cover.
8. Clutch delivery manifold ring.
9. Driving gear.
10. Driven gear.
11. LOW clutch piston (18.64 mph (30 km/h) version).
12. HIGH clutch piston (18.64 mph (30 km/h) version).
13. Gearshift lever with Dual Command (2 Speed Power Shift) cursor.
14. Pressure control valve.
15. Dual Command (2 Speed Power Shift) control valve solenoid.
16. Control valve.
17. LOW clutch accumulator (18.64 mph (30 km/h) version).
18. HIGH clutch accumulator (18.64 mph (30 km/h) version).
19. Pressure release pin.
20. Pin lever (19).
21. Clutch pedal.
22. Filter.
23. Flow divider.
24. Hydraulic pump.

NOTE: *On the 24.85 mph (40 km/h) version the HIGH and LOW clutches, and relative accumulators (18 and 17), reverse functions - i.e.: LOW becomes HIGH, and vice versa.*

HIGH CLUTCH ENGAGED HYDRAULIC DIAGRAM (30 km/h version)

With any forward gear engaged and with the cursor on the gearshift lever (13, fig. 7) in position (B), by releasing clutch pedal (21) the lever (20) releases the clutch discharge pin (19) which, by means of the spring, returns to the neutral position.

The oil, coming from the hydraulic pump (24) and regulated at a pressure of 227.72 to 242.22 psi (15.7 to 16.7 bar) by the valve (14), acts on the accumulator (18), overcomes the resistance of the spring, fills the accumulator and, through the pipe freed by the pin (19), reaches the HIGH clutch, acts on the piston (12), overcomes the resistance of the associated spring engaging the HIGH speed.

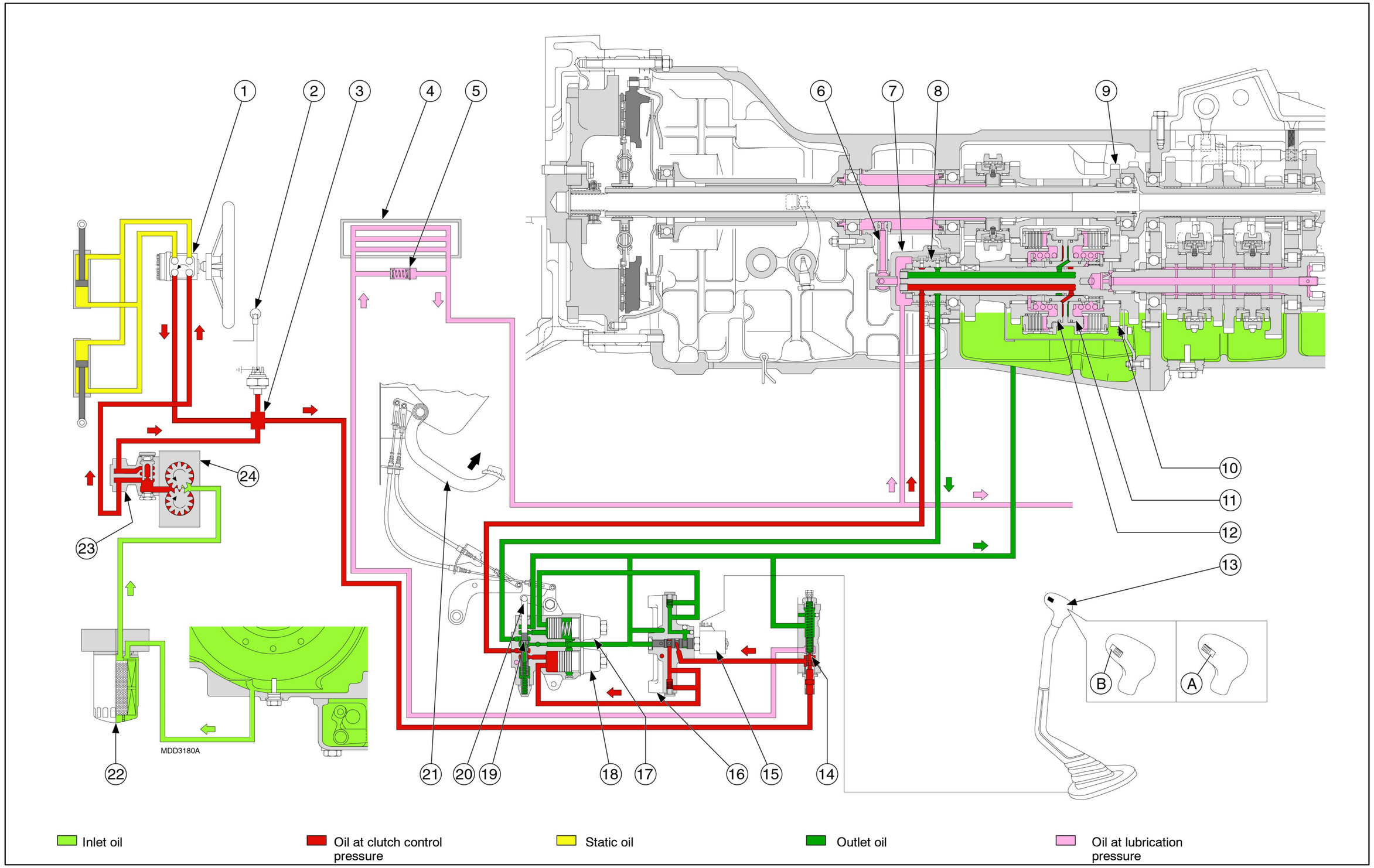
The oil from the pump now keeps the HIGH clutch engaged and, through the valve (14), is conveyed into the lubrication circuit.

NOTE: *This description refers to the 18.64 mph (30 km/h) version with HIGH speed inserted; i.e.: the cursor on the gearshift lever (13) must be in position (B).*
With the cursor in this position on the 24.85 mph (40 km/h) version, accumulator (18) is not involved whereas accumulator (17) is.
The 24.85 mph (40 km/h) version differs from the 18.64 mph (30 km/h) version only in the pair of gears (9 and 10) that changes the number of teeth and, therefore, also the ratio. The HIGH and LOW clutches, and relative accumulators (18 and 17), reverse functions - i.e.: HIGH becomes LOW, and vice versa.

HIGH clutch engaged hydraulic diagram

1. Power steering control valve.
2. Low oil pressure indicator.
3. Power steering circuit anti-cavitation tank.
4. Cooler.
5. By-pass valve.
6. Driving shaft lubrication lines.
7. Driven shaft manifold cover.
8. Clutch delivery manifold ring.
9. Driving gear.
10. Driven gear.
11. LOW clutch piston (18.64 mph (30 km/h) version).
12. HIGH clutch piston (18.64 mph (30 km/h) version).
13. Gearshift lever with Dual Command (2 Speed Power Shift) cursor.
14. Pressure control valve.
15. Dual Command (2 Speed Power Shift) control valve solenoid.
16. Control valve.
17. LOW clutch accumulator (18.64 mph (30 km/h) version).
18. HIGH clutch accumulator (18.64 mph (30 km/h) version).
19. Pressure release pin.
20. Pin lever (19).
21. Clutch pedal.
22. Filter.
23. Flow divider.
24. Hydraulic pump.

NOTE: *On the 24.85 mph (40 km/h) version the HIGH and LOW clutches, and relative accumulators (18 and 17), reverse functions - i.e.: LOW becomes HIGH, and vice versa.*


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
A
B
MDD3180A
Inlet oil
Oil at clutch control pressure
Static oil
Outlet oil
Oil at lubrication pressure

DUAL COMMAND (2 SPEED POWER SHIFT) TROUBLESHOOTING (FRONT CLUTCH)

Problems	Possible Causes	Solutions
Front clutch does not engage: the high gears do not work on the 18.64 mph (30 km/h) version or the low gears do not work on the 24.85 mph (40 km/h).	**1.** Transmission oil level insufficient.	Top up oil level.
	2. Clogged oil filter.	Replace filter.
	3. Hydraulic pump faulty.	Overhaul or replace pump.
	4. Switch faulty.	Replace switch.
	5. No power at electromagnet: connections disconnected, damaged or contactor faulty.	Check electrical connections or replace defective parts.
	6. Dual Command (2 Speed Power Shift) with reverse gear engaged safety switch faulty.	Adjust correctly or replace switch.
	7. Solenoid valve (12, fig. 4) jammed.	Overhaul or replace solenoid valve.
	8. Oil leakage through seals, leading to drop in pressure: O-ring on piping, O-ring on pistons and seal segments.	Replace all defective seals.
Engagement delay because of front clutch slipping.	**1.** Front clutch disks worn.	Replace disks.
	2. Oil leakage through seals, leading to drop in pressure: O-ring on piping, O-ring on pistons and seal segments.	Replace all defective seals.
Front clutch remains engaged.	**1.** Switch faulty.	Replace switch.
	2. No power at electromagnet: connections disconnected, damaged or contactor faulty.	Check electrical connections or replace defective parts.
	3. Solenoid valve (12, fig. 4) jammed.	Overhaul or replace solenoid valve.

(continued)

DUAL COMMAND (2 SPEED POWER SHIFT) TROUBLESHOOTING (REAR CLUTCH)

(cont)

Problems	Possible Causes	Solutions
Front clutch does not engage: the low gears do not work on the 18.64 mph (30 km/h)h version the high gears do not work on the 24.85 mph (40 km/h) version.	**1.** Transmission oil level insufficient.	Top up oil level.
	2. Clogged oil filter.	Replace filter.
	3. Hydraulic pump faulty.	Overhaul or replace pump.
	4. Switch faulty.	Replace switch.
	5. No power at electromagnet: connections disconnected, damaged or contactor faulty.	Check electrical connections or replace defective parts.
	6. Dual Command (2 Speed Power Shift) with reverse gear engaged safety switch faulty.	Adjust correctly or replace switch.
	7. Solenoid valve (12, fig. 4) jammed.	Overhaul or replace solenoid valve.
	8. Oil leakage through seals, leading to drop in pressure: O-ring on piping, O-ring on pistons and seal segments.	Replace all defective seals.
Engagement delay because of rear clutch slipping.	**1.** Rear clutch disks worn.	Replace disks.
	2. Oil leakage through seals, leading to drop in pressure: O-ring on piping, O-ring on pistons and seal segments.	Replace all defective seals.
Rear clutch remains engaged.	**1.** Switch faulty.	Replace switch.
	2. No power at electromagnet: connections disconnected, damaged or contactor faulty.	Check electrical connections or replace defective parts.
	3. Solenoid valve (12, fig. 4) jammed.	Overhaul or replace solenoid valve.

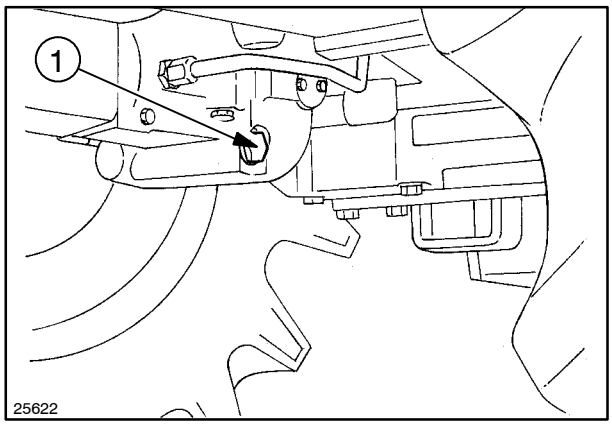
Op. 21 110 10
CLUTCH CASING WITH DUAL COMMAND (2 SPEED POWER SHIFT) R.I.

DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

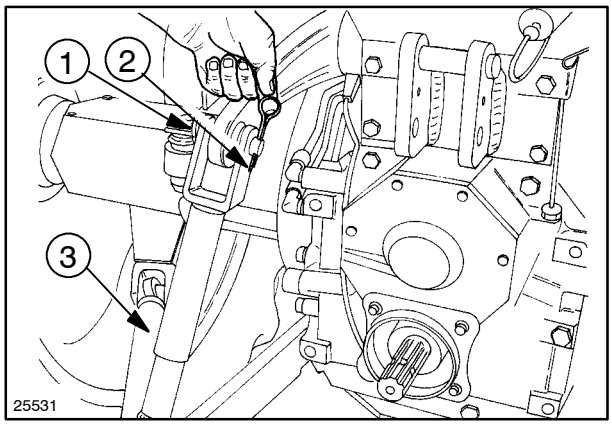
To detach the clutch casing with the Dual Command (2 Speed Power Shift) remove the cab and the platform (see Section 90) then proceed as follows.

1. Disconnect the negative battery cable, unscrew the plug (1) and drain the oil from the gearbox-transmission casing.



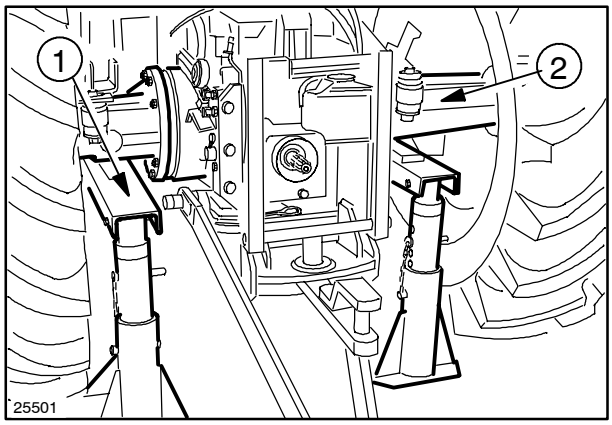
8

2. Extract the pins (1) after having removed the split pins, detach the vertical tie-rods (2) on the lift arms and the lower lift arms, then remove the anti-swing tie-rods (3).



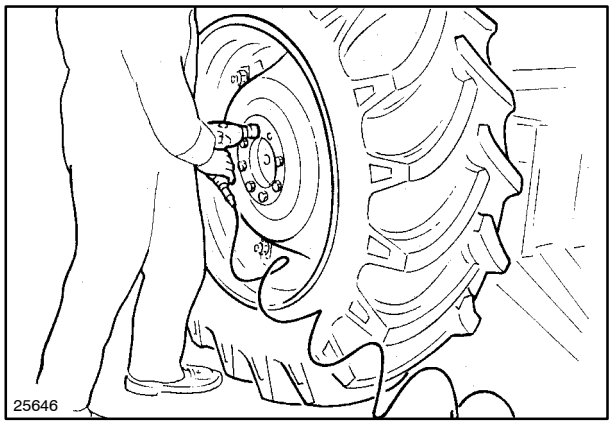
9

3. Raise the rear part of the tractor, positioning two fixed stands (1) under the final drive casings (2).



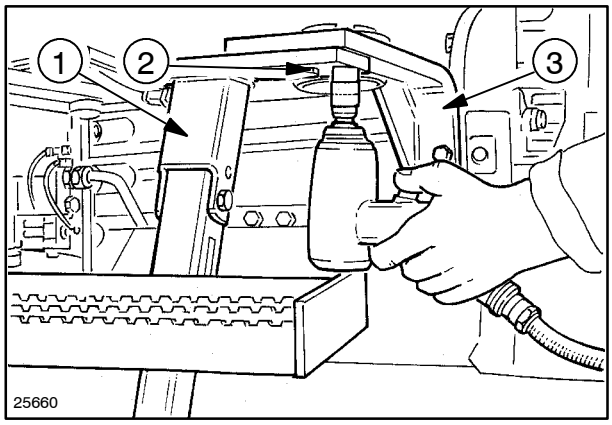
10

4. Remove the rear wheels.



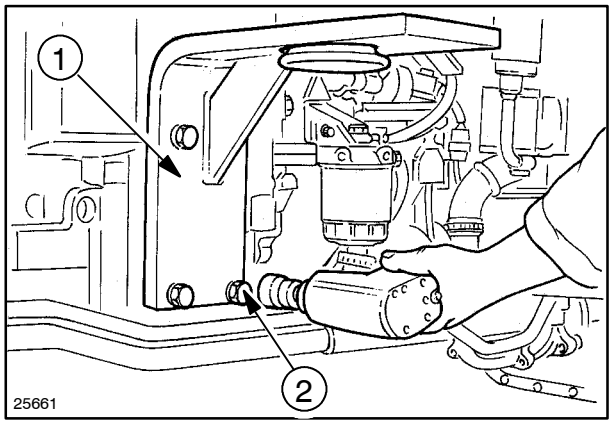
11

5. Take out the screws (2) and remove the steps (1) to the cab (on both sides); take out the relevant retaining bolts and remove the bracket (3) supporting the cab (left-hand side).



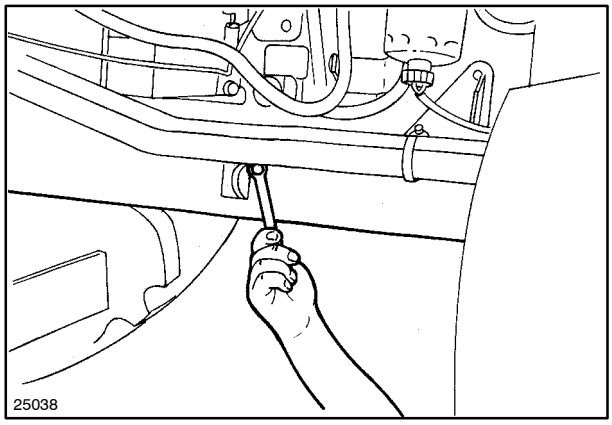
12

6. Take out the screws (2) and remove the bracket (1) supporting the cab (right-hand side).



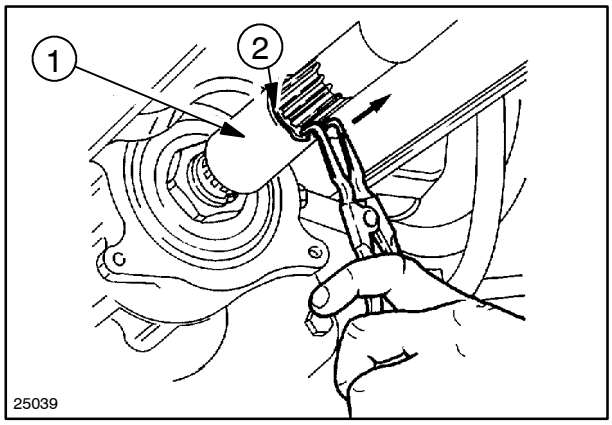
13

7. Unscrew the front, central and rear bolts securing the drive shaft guard.



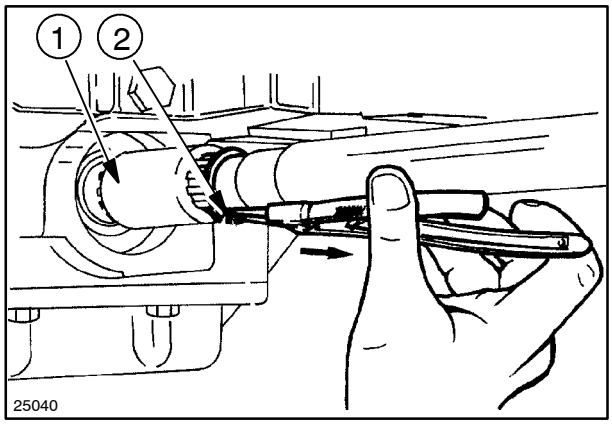
14

8. Take off the circlip (2) and extract the sleeve (1) from the front axle.



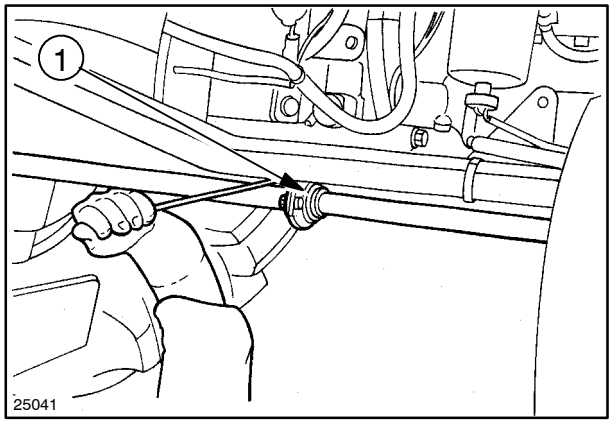
15

9. Take off the circlip (2) and extract the sleeve (1) from the drive.



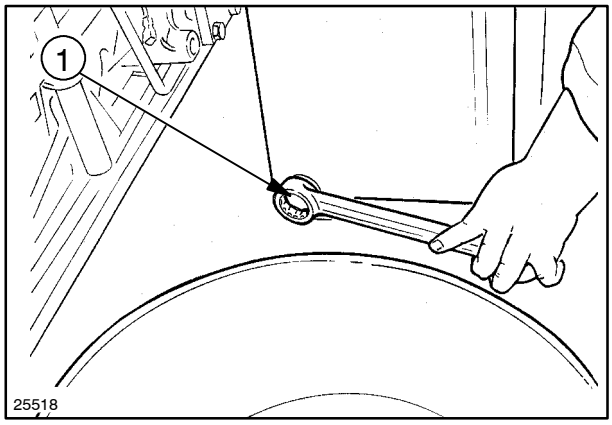
16

10. Take out the retaining bolts of the propeller shaft central support (1) and remove the shaft together with its support.



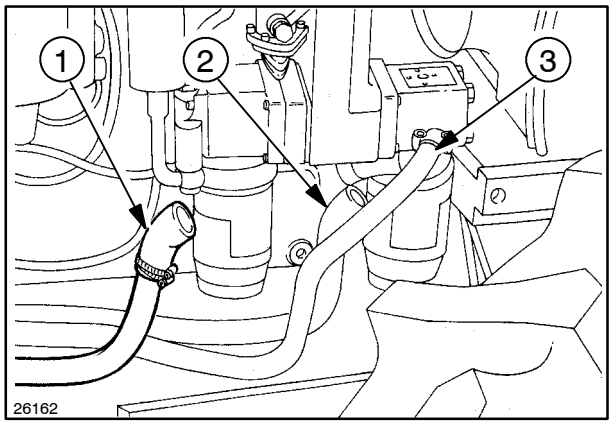
17

11. Remove the plug (1) and drain off the fuel tank into a suitable container (tank capacity is 110 litres).



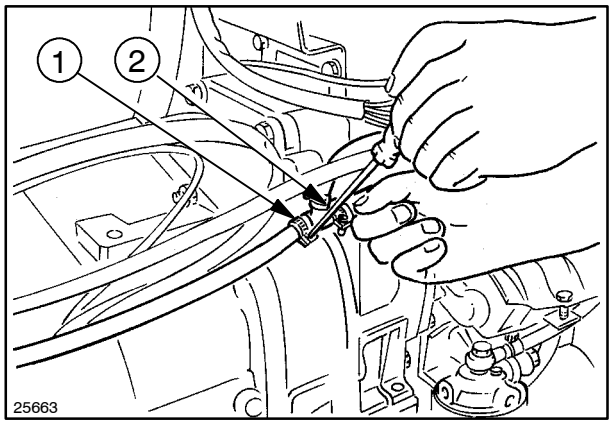
18

12. Detach the two hydraulic pump intake lines (1 and 2) and the hydraulic lift delivery line (3).
13. Detach the bracket on the brake lines, bend the lines towards the front part of the tractor taking care not to crush the lines.



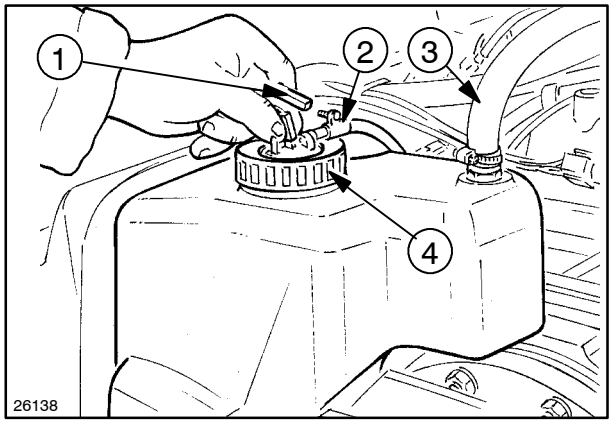
19

14. Remove the clamps (1) and detach the fuel delivery three-way union (2).



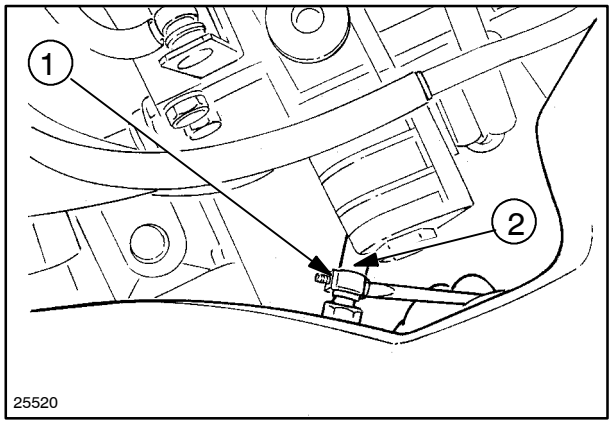
20

15. Disconnect the electrical connections (1) and the fuel return line (2) located on the fuel gauge unit (4) and detach the breather pipe (3).



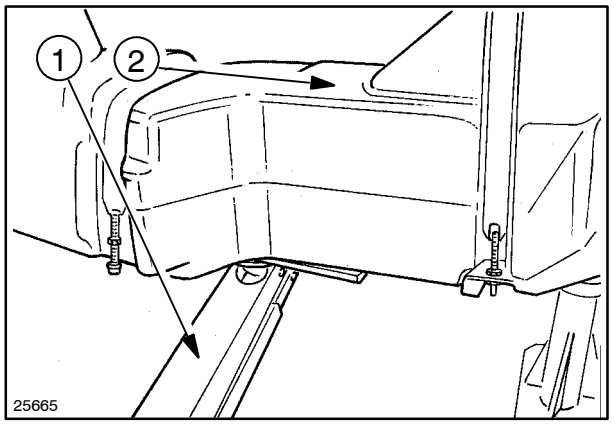
21

16. Take off the clamp (1) and remove the injection pump supply pipe (2).



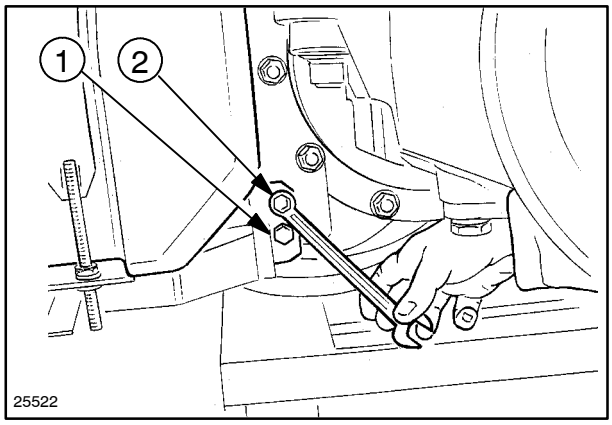
22

17. Position a hydraulic jack (1) under the central part of the tank (2) and slightly raise to facilitate disassembly operations.



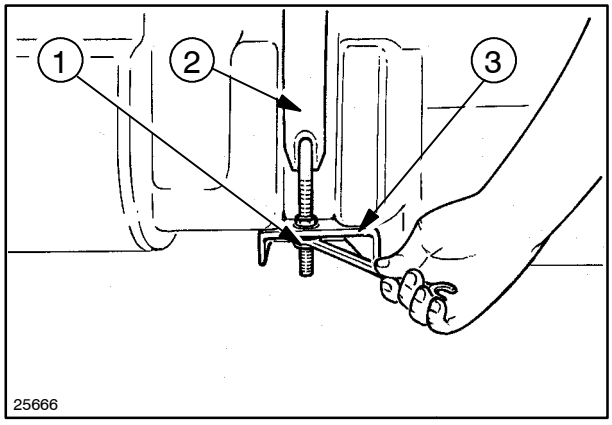
23

18. Take out the two bolts (1) retaining the rear bracket (2) supporting the tank.



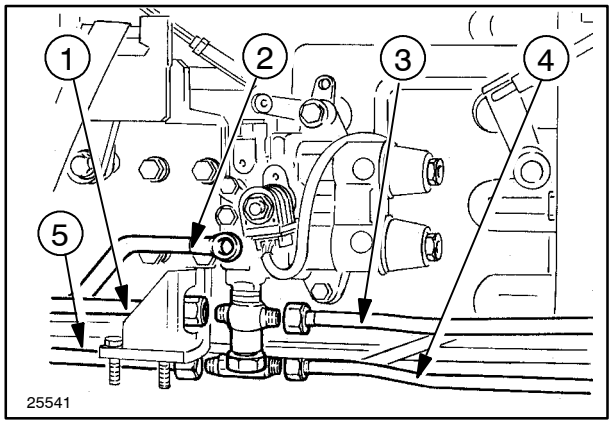
24

19. Remove the nut (1) securing the clamp (2) and extract it from the support bracket (3), detach the front clamp and remove the tank.



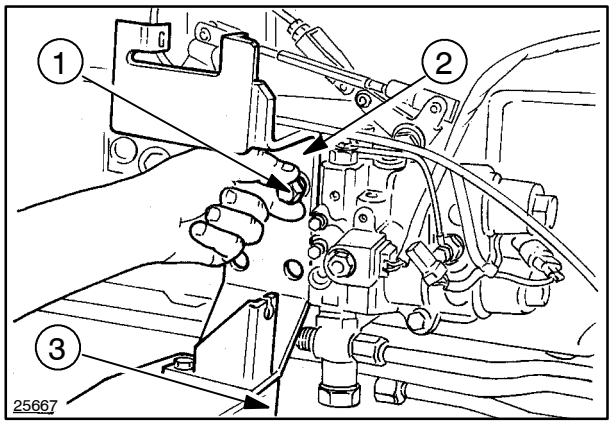
25

20. Remove the unions and detach the lines (1, 2, 3, 4 and 5) from the Dual Command (2 Speed Power Shift) control valve.



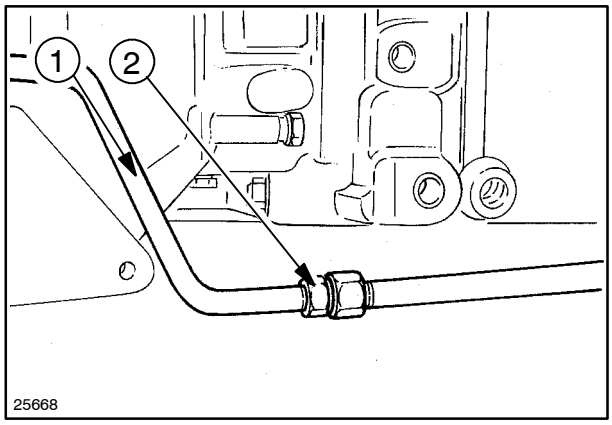
26

21. Take out the bolts (1) and remove the bracket (2) supporting the front bracket (3) of the fuel tank.



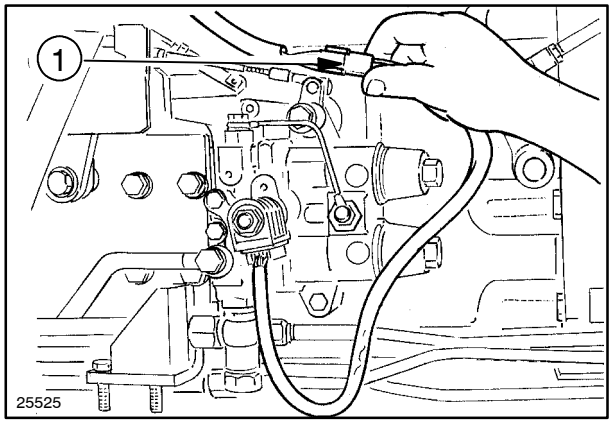
27

22. Remove the union (2) and disconnect the front axle differential lock pipe (1).



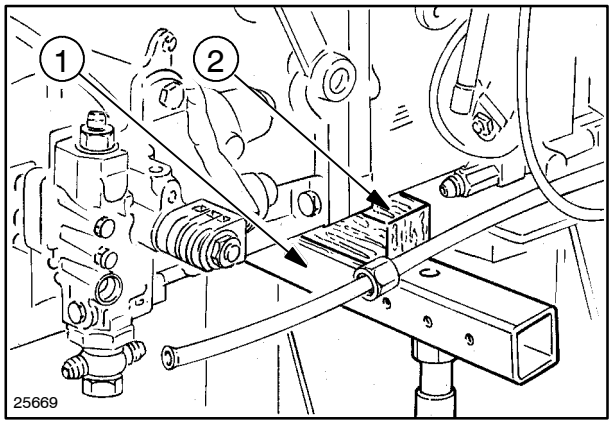
28

23. Connect the electrical connection (1) of the Dual Command (2 Speed Power Shift) solenoid valve.



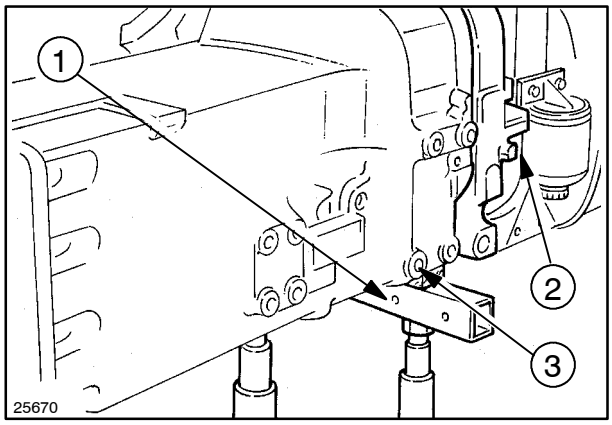
29

24. Position the fixed stand (1) on tool **380000236** under the transmission casing, insert a wooden block (2) between the stand and the transmission casing.



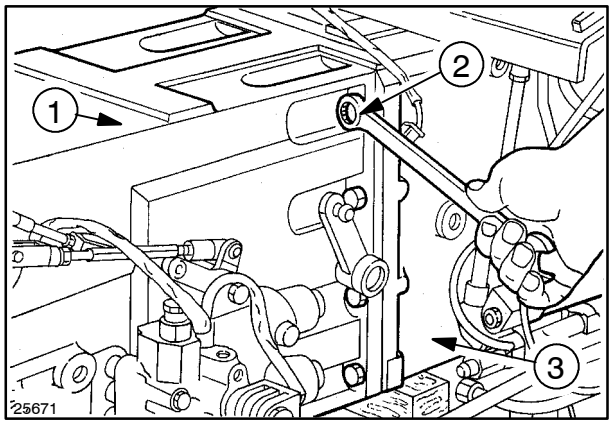
30

25. Position the mobile trolley (1) on tool **380000236** under the clutch casing (2), inserting a wooden block (3) between the trolley and the clutch casing then place a support column under the tow-bar.



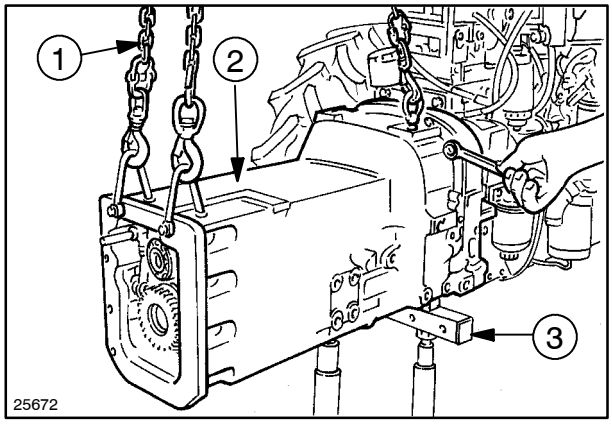
31

26. Take out the bolts (2) securing the clutch casing (1) to the rear transmission casing (3) and separate the two casings.



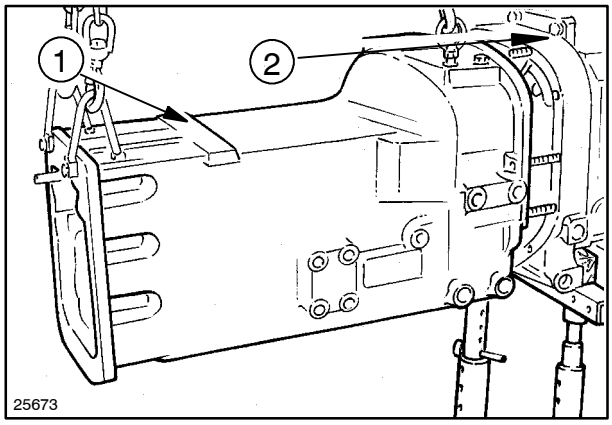
32

27. Move the mobile trolley (3) under the sump, connect the chains on hook **380000227** (1) to the clutch casing (2) and take up the strain with a hoist.



33

28. Remove the bolts and nuts securing the clutch casing (1) with the Dual Command (2 Speed Power Shift) to the engine (2) and remove the casing (1).



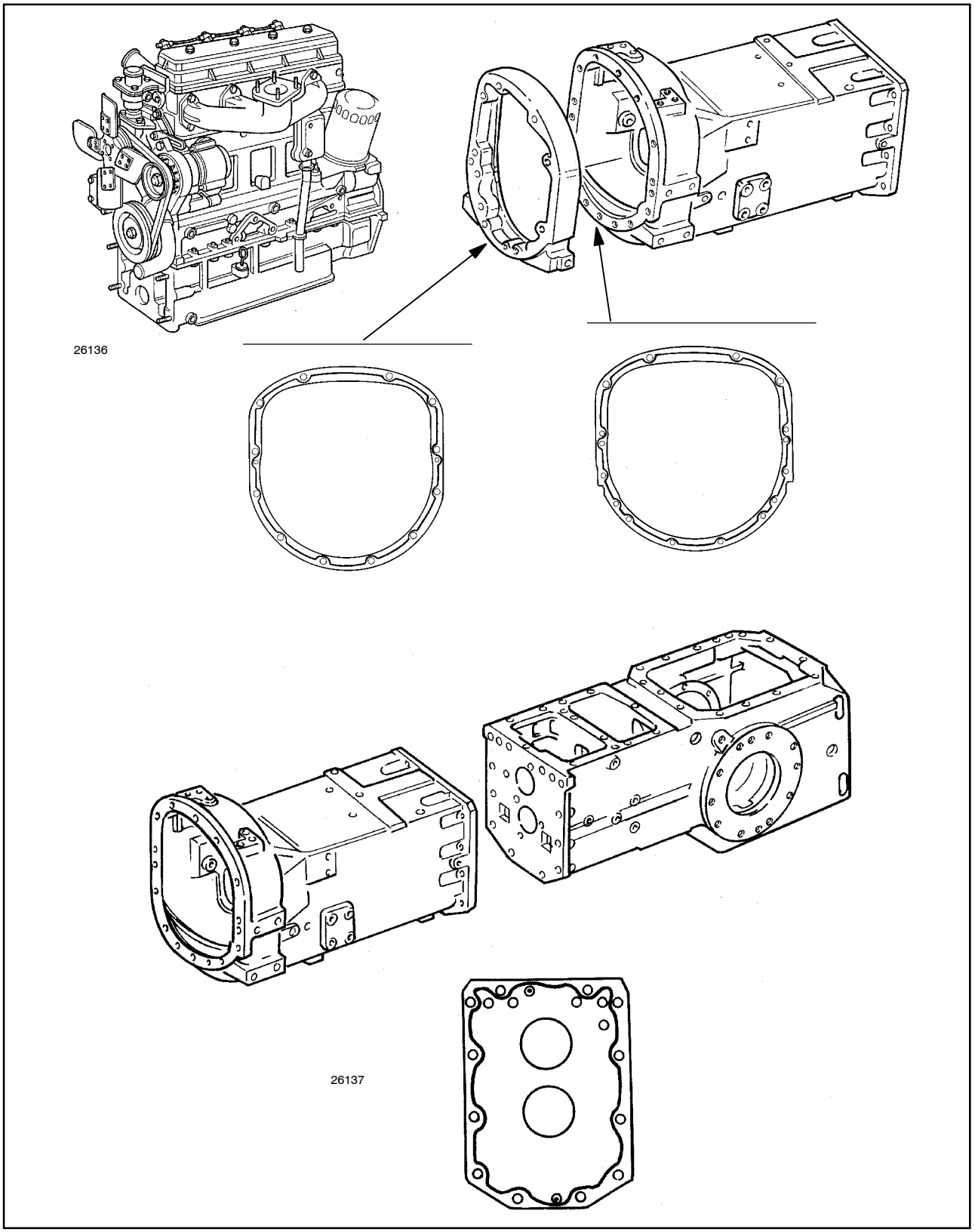
34

29. Re-assemble the clutch casing with the Dual Command (2 Speed Power Shift) in observance of the warnings below.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Before refitting the clutch casing to the engine and to the rear transmission casing, carefully clean the mating surfaces and apply a bead of sealing compound (0.0787 in. (2 mm) diameter), according to the diagram shown in figure 35.
- Respect the tightening torques prescribed on page 4.
- Using hook **380000227** and a hoist refit the clutch casing to the engine and secure by tightening the relative bolts or nuts to the prescribed torque value.
- Position the mobile trolley on tool **380000236** under the clutch casing. Smear the splining grooves on the transmission and PTO drive shafts with **AMBRA GR 9** grease.
- Move the engine-clutch casing unit towards the gearbox-transmission casing using tool **380000236** and acting on the front wheels.
- Tighten the retaining bolts to the prescribed torque value and release hook **380000227**.
- Remove the mobile trolley from under the clutch casing and the fixed stand from under the transmission-gearbox casing.
- Connect the clutch tie-rod and secure the sheath in the relative bracket.
- Connect the solenoid valve electrical connection to the Dual Command (2 Speed Power Shift) control valve.
- Refit the lines on the Dual Command (2 Speed Power Shift) control valve and the solenoid valve support, then refit the front differential lock piping.
- Assemble the tank support front bracket and cab support.
- Assemble the gearbox-transmission oil heat exchanger piping and secure with the relative bracket.
- Fit the Dual Command (2 Speed Power Shift) control valve feed line.
- Fit the tank, resting it on the two support brackets.
- Secure the tank with the two metal clamps. Insert the fuel return hose in the union on the tank cap.
- Connect the fuel pump hose.
- Tighten all the unions and clamps and secure the various pipes and hoses with clamps.
- Connect the fuel gauge unit connections.
- Connect the transmission-gearbox oil breather pipe.
- Connect the 3-way union to the various fuel return lines.
- Straighten the brake control lines and secure with the bracket.
- Connect the two hydraulic pump pipes and the hydraulic lift delivery line.
- Fit the trailer brake control valve pipe to the 4WD casing.
- Fit the drive shaft and relative guard.
- Assemble the RH cab support bracket and secure to the clutch casing with the retaining bolts.
- Fit the two cab access steps.
- Fit the rear wheels, raising the tractor with a hoist and a nylon sling. Extract the two fixed stands from under the final drives and the column from under the towbar.
- Fit the two lift vertical tie-rods and the two anti-swing rods.
- Make sure that all the transmission-gearbox drainage plugs are tightened and fill up with the quantities described in **Section 00**.
- Fill up the fuel tank.
- Connect the negative cable to the battery.



35

Sealing compound application diagram for fitting the clutch casing to the engine and to the gearbox-rear transmission casing.

NOTE: *The types of sealing compounds to be applied are specified in Section 00.*

Op. 21 110 87
CLUTCH CASING WITH DUAL COMMAND (2 SPEED POWER SHIFT) D.A.

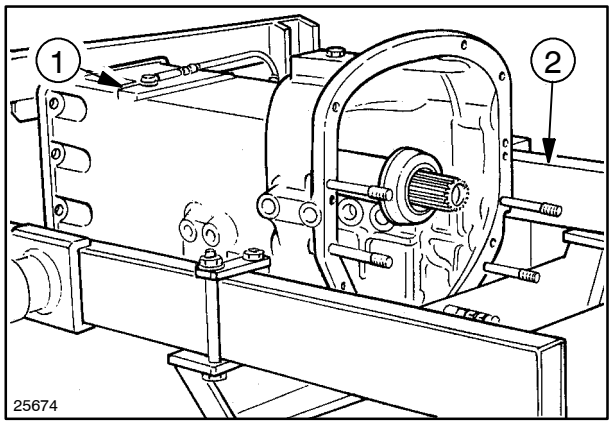
CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

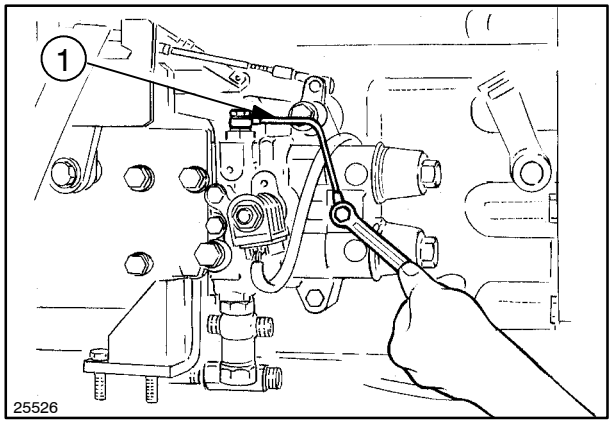
NOTE: *The following operations must be performed with the clutch casing (1) secured onto the rotating stand* ***380000301*** *(2) with the front bracket* ***380000271*** *and rear bracket* ***380000272****.*

Proceed as follows:

1. Detach the pipe (1) on the Dual Command (2 Speed Power Shift) control valve.

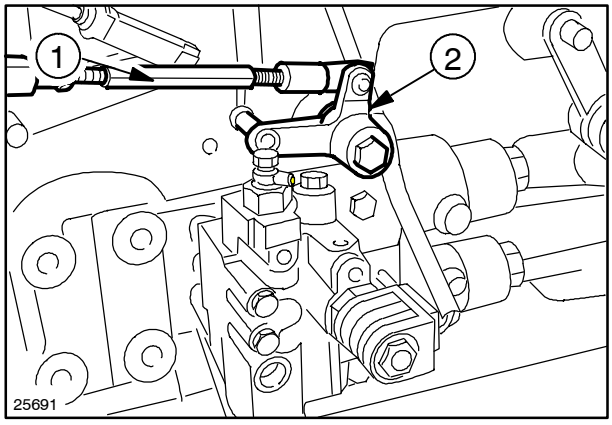


36



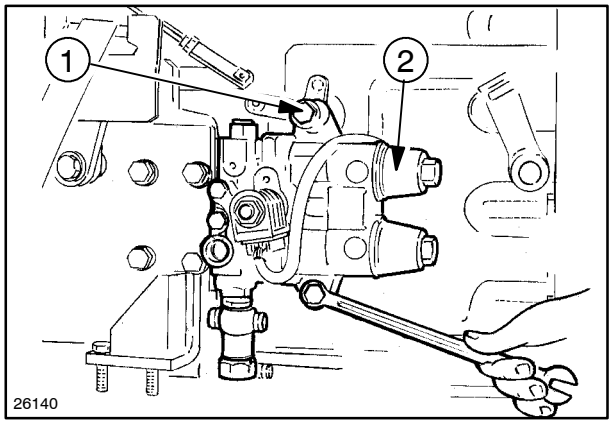
37

2. Detach the tie-rod (1) on the Dual Command (2 Speed Power Shift) exhaust/clutch lever (2).



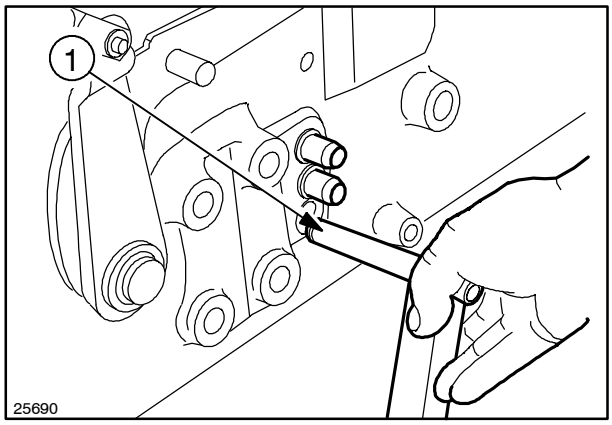
38

3. Take out the bolts (1) securing the control valve to the clutch casing. Remove the Dual Command (2 Speed Power Shift) control valve (2).



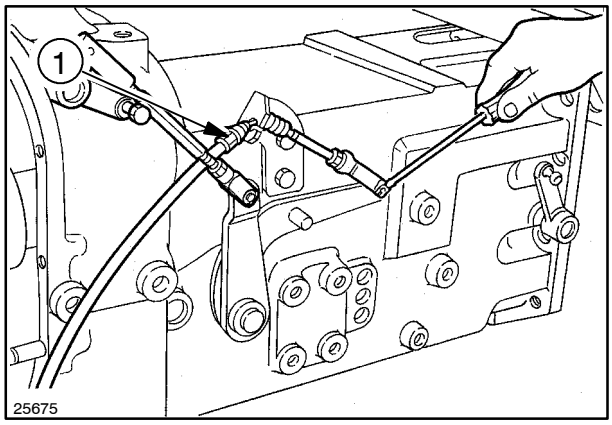
39

4. Detach the three pipes (1) connecting the Dual Command (2 Speed Power Shift) control valve to the internal manifold.



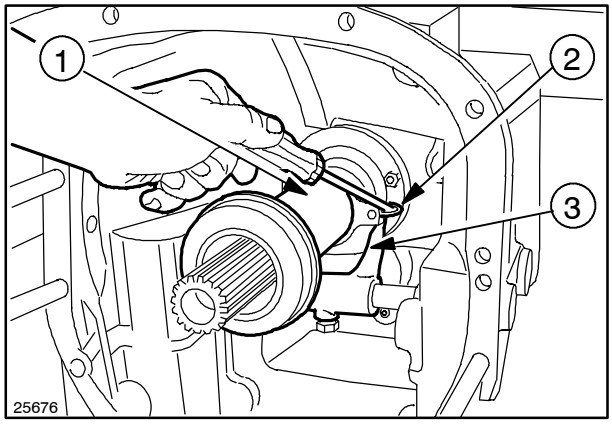
40

5. Detach the tie-rod (1) from the clutch control lever.



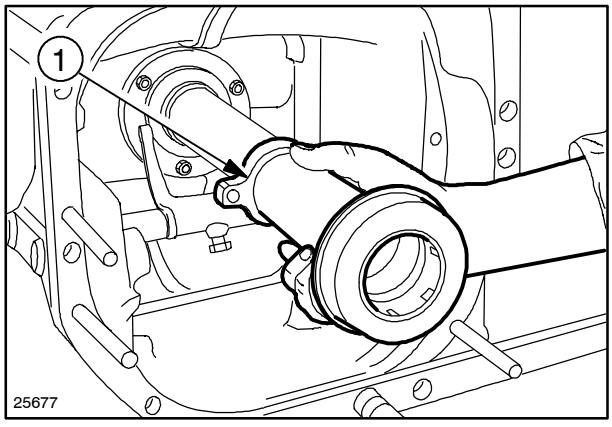
41

6. Working from the front of the clutch casing, remove the clips (2) locking the fork (3) to the sliding sleeve (1).



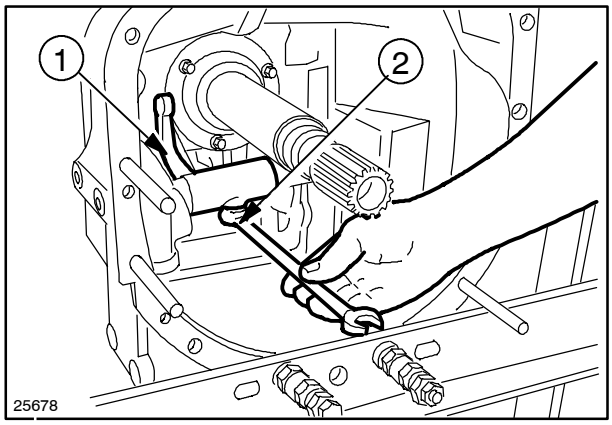
42

7. Extract the sliding sleeve (1).



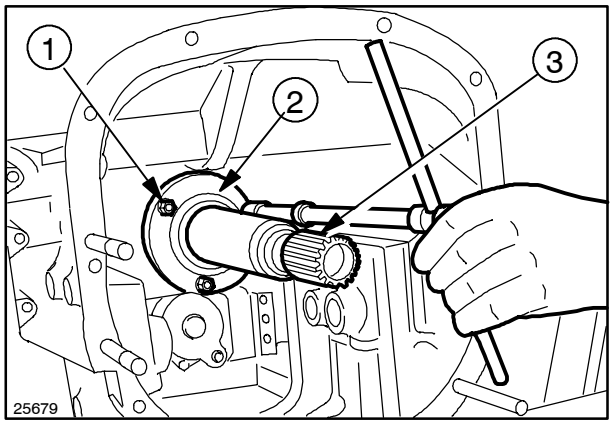
43

8. Take out the bolt (2), extract the clutch control lever and remove the fork (1).



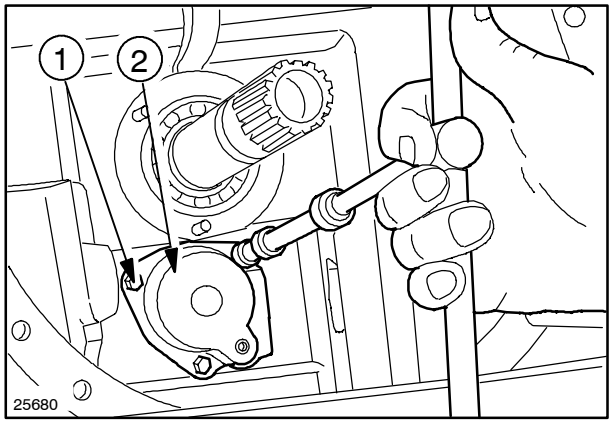
44

9. Remove the three retaining nuts (1) on the flange (2) of the gear driving shaft support (3).



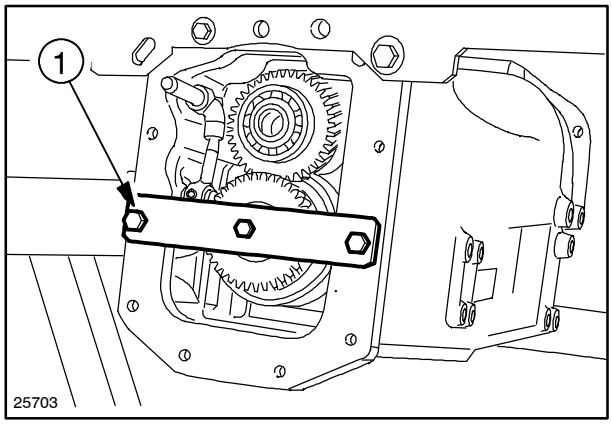
45

10. Unscrew the three bolts (1) and remove the internal manifold (2).



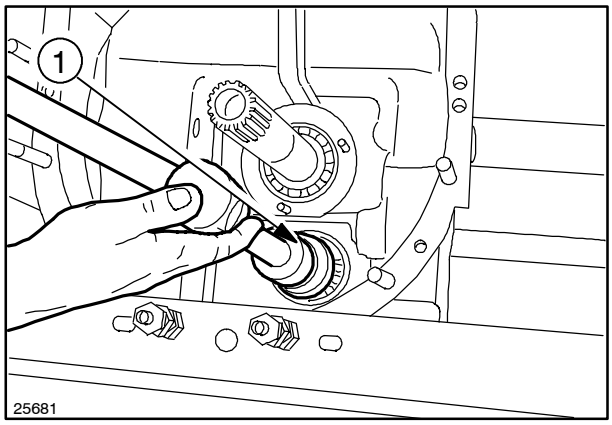
46

11. Fit tool **380000244** (1) on the rear part of the clutch casing to hold the driven shaft in position.



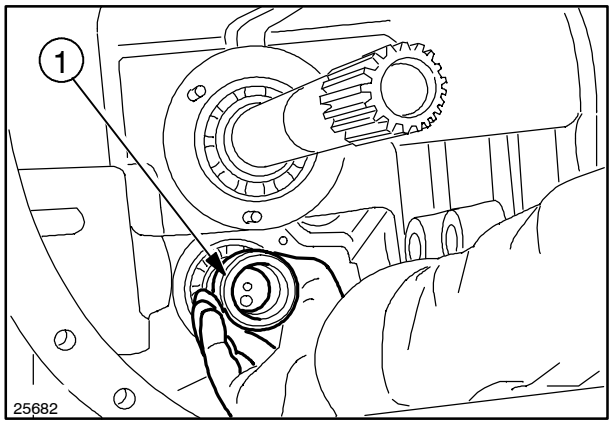
47

12. Working from the front part of the clutch casing, release the nut (1) and unscrew.



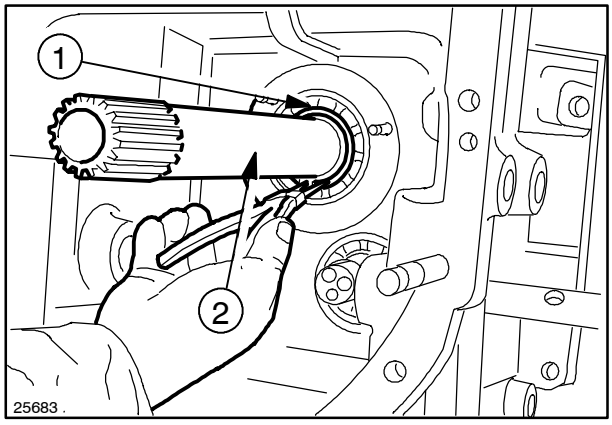
48

13. Extract the manifold ring (1) complete with the metal seal segments.



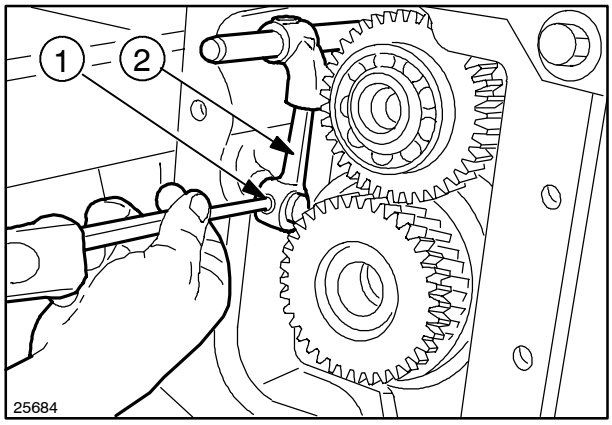
49

14. Extract the bearing snap ring (1), from the driving shaft (2).



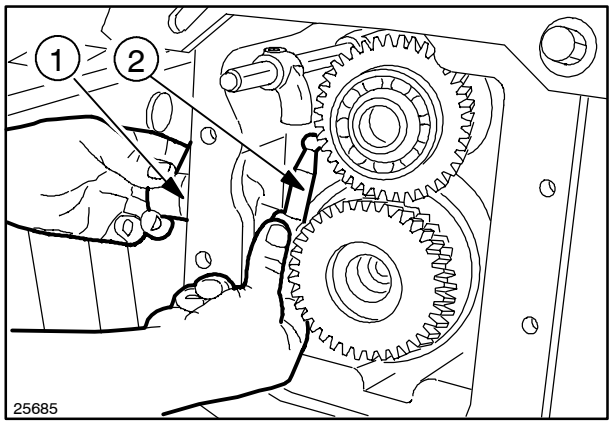
50

15. Working from the rear part of the clutch casing, remove tool **380000244** from the casing and, using a mallet and punch, extract the pin (1) locking the reverser control lever (2).



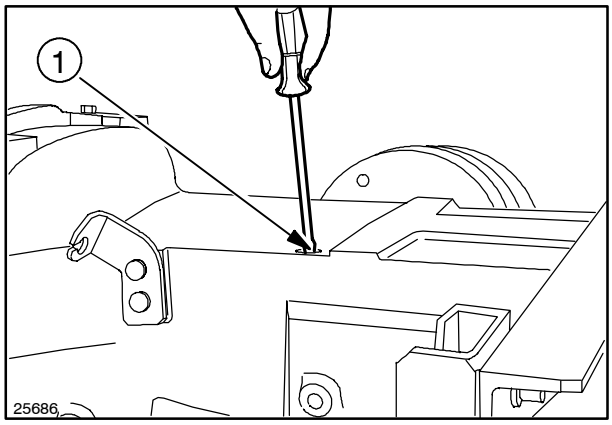
51

16. Extract the external lever (1) and remove the internal lever (2).



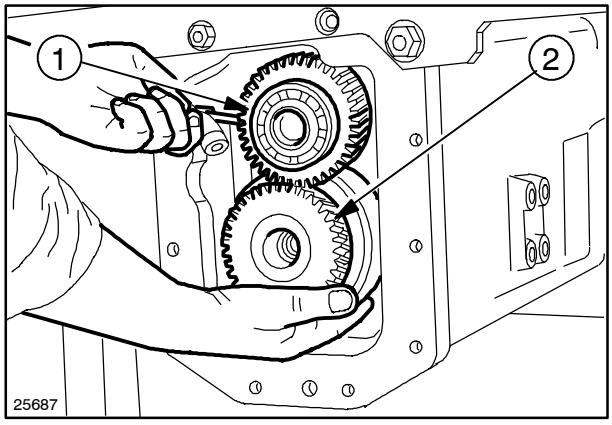
52

17. Undo the screw (1) and remove the spring and ball.



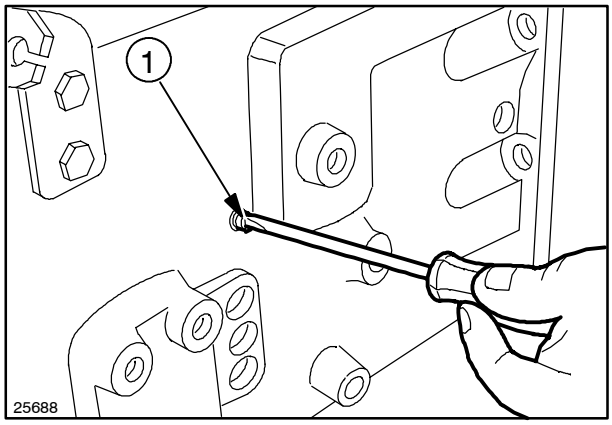
53

18. Working from the front of the clutch casing, strike the transmission driving shaft and remove the driving shaft (1) and driven shaft (2) together with the reverser synchroniser control fork and rod from the rear.
19. Remove the driven shaft bearing, bearing, snap ring and driving shaft spacer from the clutch casing.



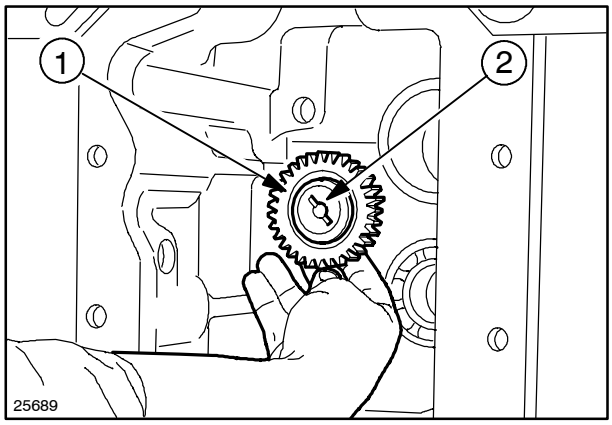
54

20. Unscrew the reverse gear pin grub screw (1).



55

21. Extract the reverse gear (1) and the pin (2) and remove the bearing.

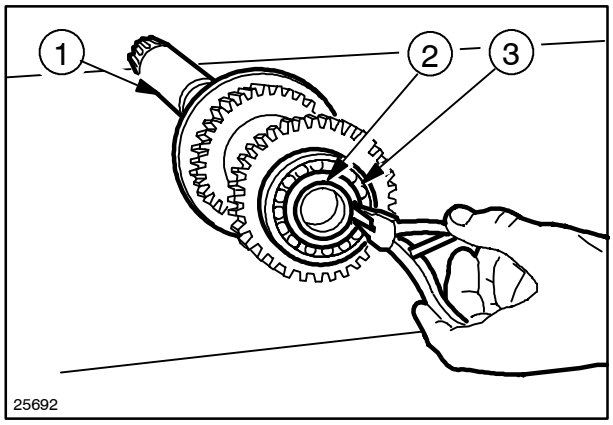


56

Driving shaft Disassembly-Assembly

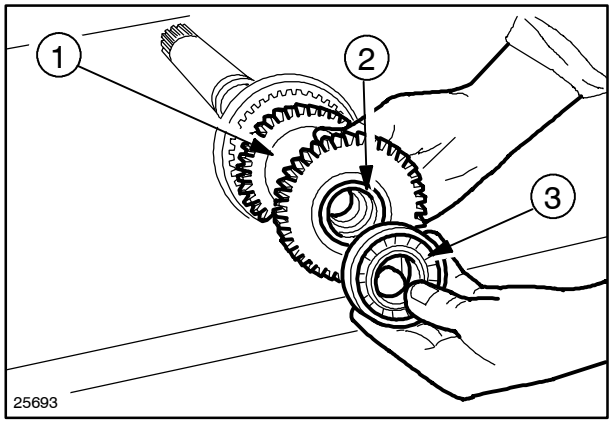
Proceed as follows:

22. Detach the bearing (3) snap ring (2) from the driving shaft (1).



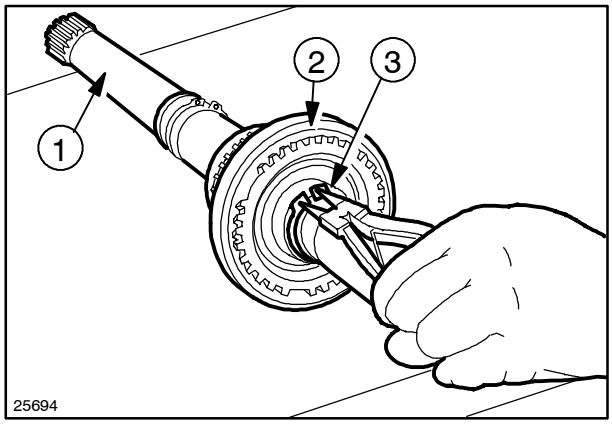
57

23. Extract the bearing (3) and spacer, the Dual Command (2 Speed Power Shift) driving gear (1) and remove the roller bearings (2).



58

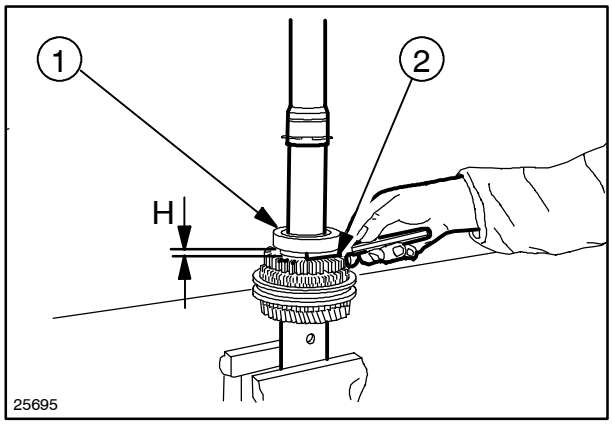
24. Detach the snap ring (3) and extract the reverser synchroniser unit (2) from the driving shaft (1).



59

25. Fit the parts shown in the figure on the driving shaft, proceeding as follows:

- Using a feeler gauge, check that the clearance (H) between the bearing (1) and the relative thrust washer (2) is between 0 to 0.0039 in. (0 to 0.1 mm).
- If not replace the adjusting ring (3, fig. 2) selected among those listed on page 2, so as to come within the above-mentioned clearance (H).

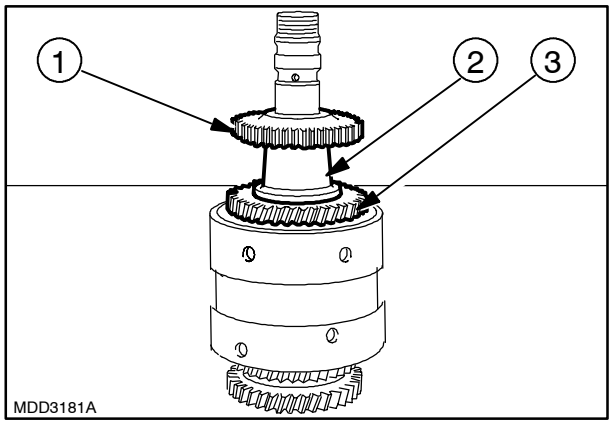


60

Driven shaft Disassembly-Assembly

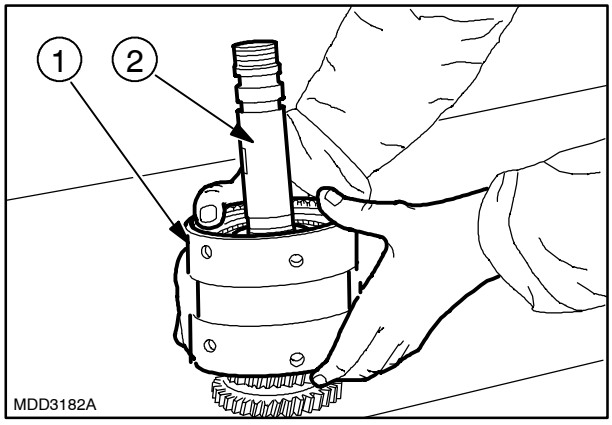
Proceed as follows:

26. Remove the reverse driven gear (1), spacer (2), HIGH clutch gear (3), the relative roller bearing and thrust washer.



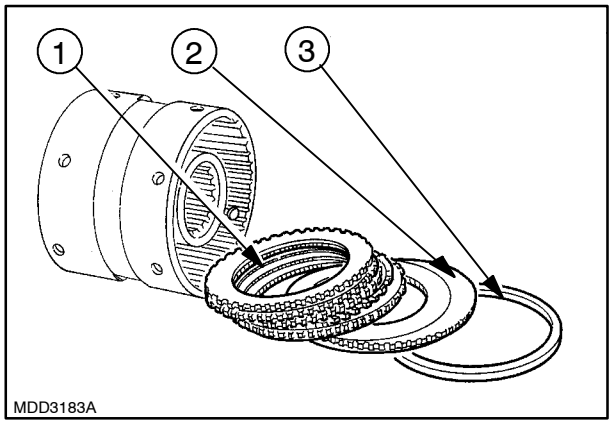
61

27. Remove the clutch assembly (1) by extracting it from the driven shaft (2).



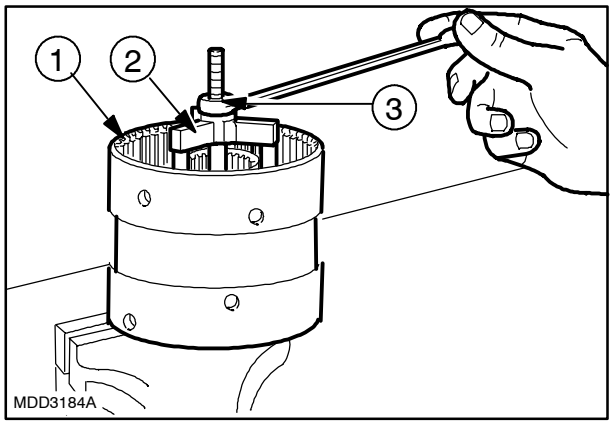
62

28. Remove the circlip (3), clutch reaction disk (2) and extract the clutch plates (1).
Repeat the operation on the other clutch.



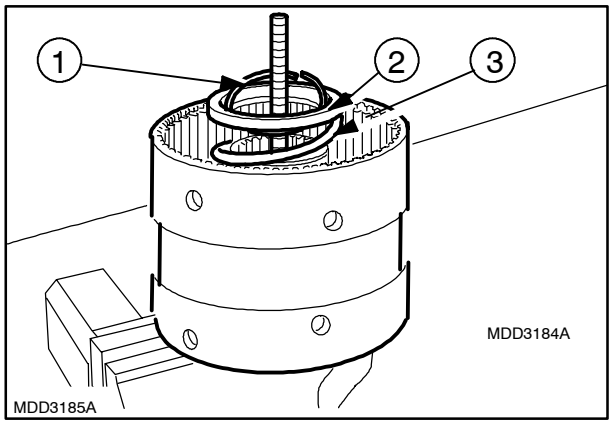
63

29. Position tool **380000243** (2) on the clutch body (1) and secure in a vice, then compress the spring by tightening nut (3).



64

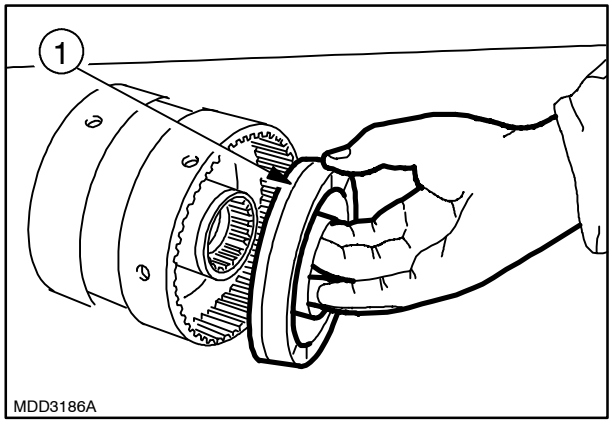
30. Remove the circlip (1) retaining the cup (2), unscrew the nut of tool **380000243** and remove the spring (3) together with the above-mentioned parts.



65

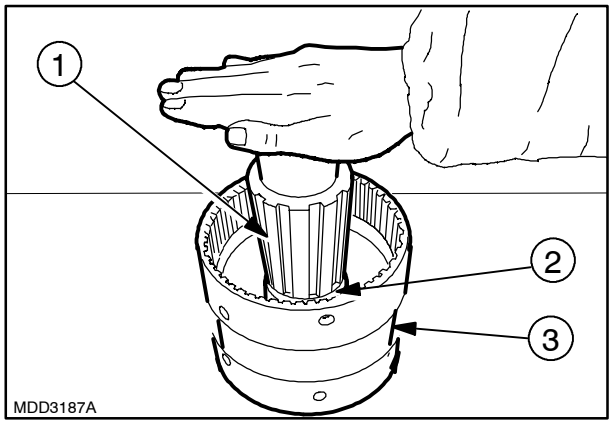
31. Remove piston (1) using a compressed air jet.
32. Repeat operations no. 29 and 30 on the opposite side and remove the snap ring, cup, spring and piston.
33. Fit the driven shaft following the disassembly operations in reverse; proceed as follows:

- Check the wear on the various components, especially the seals, replacing if necessary.



66

- Position the guide on tool **380000245** (1) on the clutch casing hub (3), fit the seal (2) and push it into its seat using the press of tool **380000245** (1).
- Repeat the same operation for the seal on the hub on the opposite side too.



67

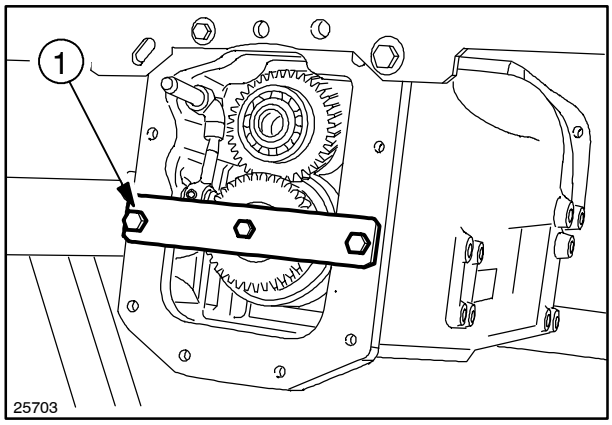
NOTE: *After having positioned the two seals (2) on the hubs, allow to settle in the seats for at least 15 minutes before fitting the clutch control pistons.*

34. To refit the various parts on the clutch casing, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Study the illustrations in figs. 2 and 3 for the positioning of the various parts.
- Ensure that the casing is cleaned thoroughly, in particular internal sections.
- Check the seals and replace if damaged.
- Respect the tightening torques prescribed on page 4.
- Assemble the reverse gear unit.
- Assemble the driving shaft complete with reverser control levers.
- Assemble the driven shaft.
- Assemble the reverser internal and external lever and secure in position with the circlip.
- Fit tool **380000244** (1) on the rear part of the clutch casing.
- Assemble the bearing and the manifold ring, complete with metal segments and seals on the driven shaft, secure with the nut and lock in position, then secure the driving shaft with the relative snap ring.
- Assemble the manifold cover.
- Remove tool **380000244** (1).
- Assemble the clutch sliding sleeve support flange.
- Assemble the clutch control fork and lever.
- Insert the sliding sleeve and secure with the spring on the fork rod.
- Insert the three control valve-manifold connecting lines.
- Assemble the Dual Command (2 Speed Power Shift) control valve assembly and connect the tie-rods and control lines.



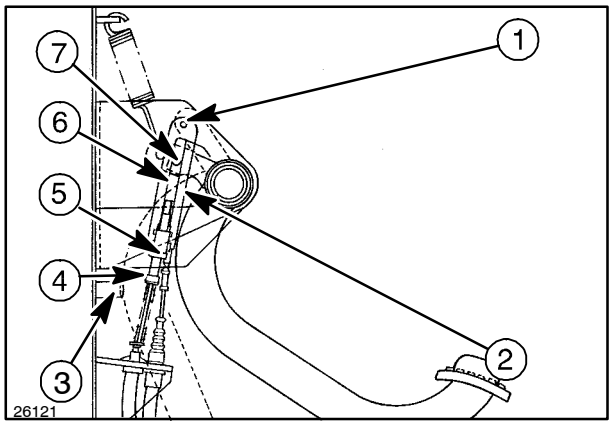
68

Op. 21 168 05
DUAL COMMAND (2 SPEED POWER SHIFT) CONTROL ROD ADJUSTMENTS

NOTE: *The control rod must be adjusted after any operations carried out on the unit .*

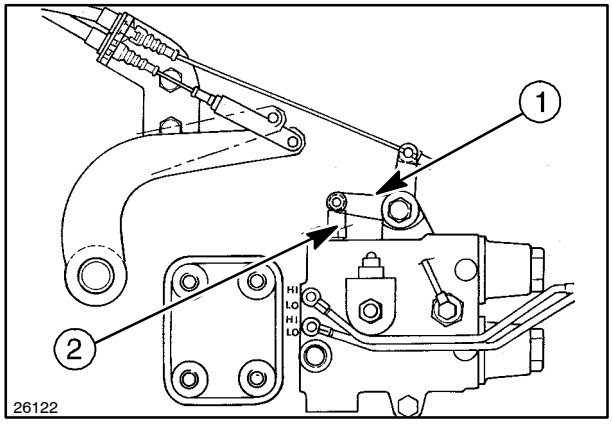
To adjust the Dual Command (2 Speed Power Shift) control rod remove the LH side panel on the dashboard to access the clutch pedal zone.

1. Move the clutch pedal up against the stop (3).
2. Connect the Dual Command (2 Speed Power Shift) clutch to the respective pedal.



69

3. Screw down the adjusting nut (4 fig. 69) so that via the lever (1 fig. 70) the Dual Command (2 Speed Power Shift) clutch control pin (2) is brought onto the bottom limit stop.
4. With pin (2) at the lower limit stop, unscrew the adjusting nut (4) to retract the pin (2) by 0.0196 to 0.0393 in. (0.5 to 1 mm) and tighten the locknut (5).
5. Carry out a few control manoeuvers and check that the value of 0.0196 to 0.0393 in. (0.5 to 1 mm) remains unaltered.
6. Refit the fuel tank.



70

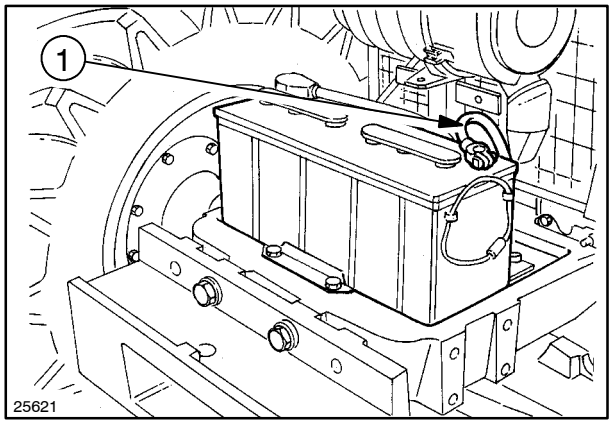
Op. 21 168 21
DUAL COMMAND (2 SPEED POWER SHIFT) SOLENOID VALVE R.I.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

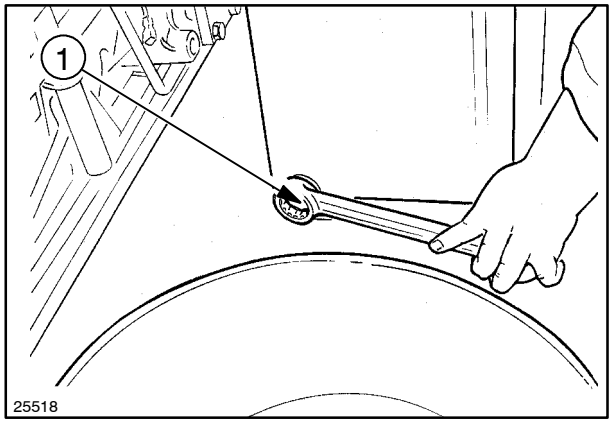
To remove the Dual Command (2 Speed Power Shift) solenoid valve, proceed as follows:

1. Disconnect the battery negative cable (1).



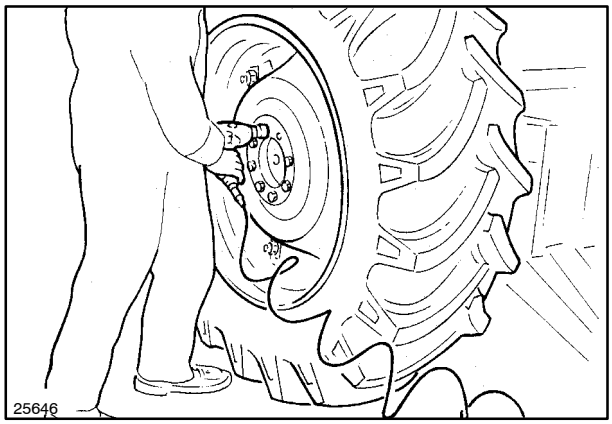
71

2. Remove the plug (1) and drain off the fuel tank into a suitable container (tank capacity is 29.05 gallons (110 litres).



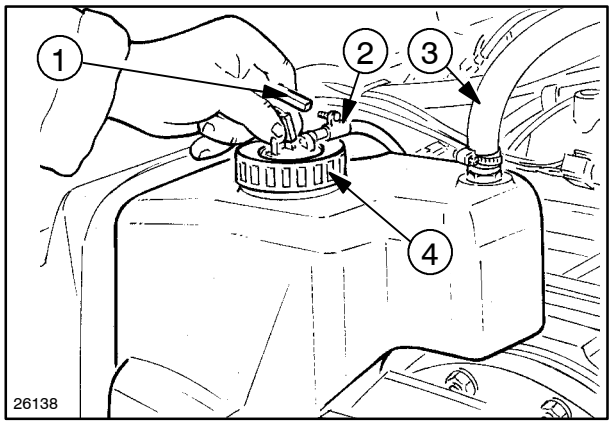
72

3. Insert a stand under the LH final drive casing and detach the wheel.



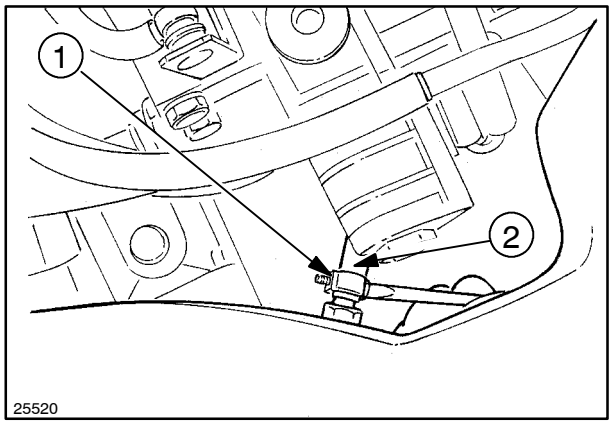
73

4. Disconnect the electrical connections (1) and the fuel return line located on the fuel gauge unit (4) and detach the breather pipe (3).



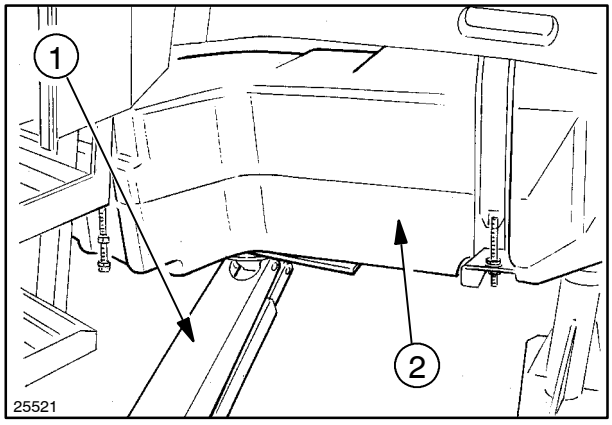
74

5. Take off the clamp (1) and remove the injection pump supply pipe (2).



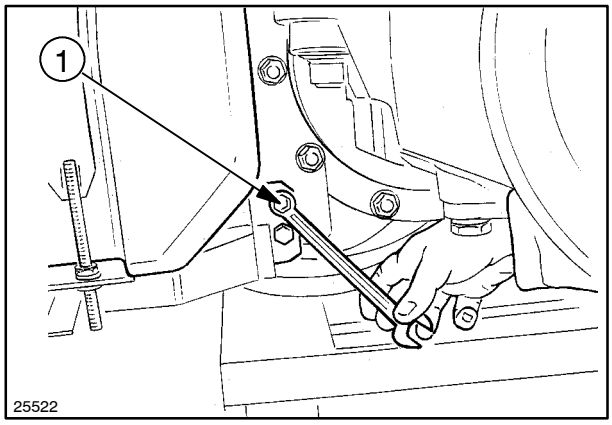
75

6. Position a hydraulic jack (1) under the central part of the tank (2) and slightly raise to facilitate disassembly operations.



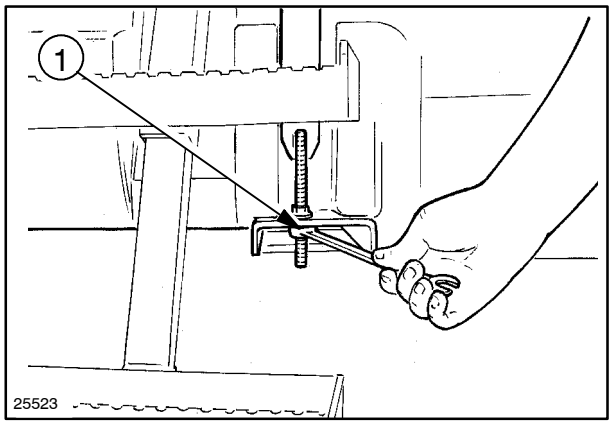
76

7. Take out the two bolts (1) retaining the rear bracket supporting the tank.



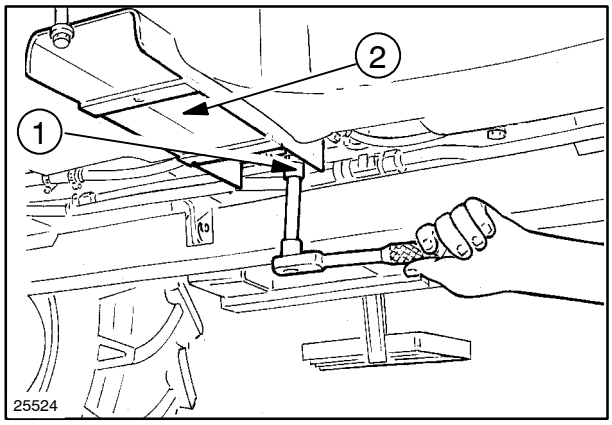
77

8. Unscrew the nut (1) securing the front clamp and repeat the operation on the rear clamp too.



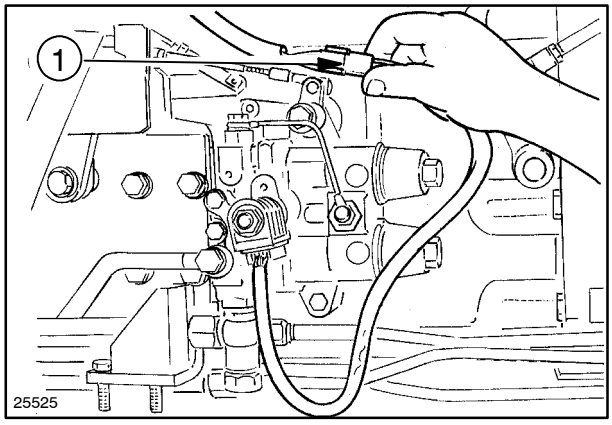
78

9. Take out the bolts (1) retaining the front bracket (2) and detach it, then lower the hydraulic lift and remove the fuel tank.



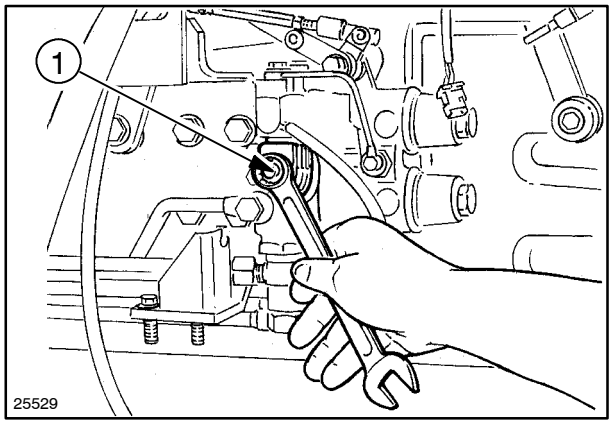
79

10. Detach the electrical connection (1) from the Dual Command (2 Speed Power Shift) solenoid valve.



80

11. Unscrew the nut (1) and detach the solenoid valve.



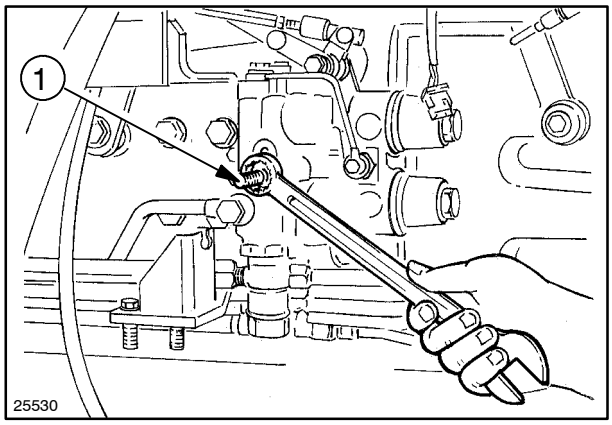
81

12. If necessary, remove the solenoid valve pin (1).
13. To refit the solenoid valve to the Dual Command (2 Speed Power Shift) control valve proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Fit the pin (1) and the solenoid valve.
- Connect the electrical connection on the Dual Command (2 Speed Power Shift) solenoid valve.
- Assemble the fuel tank, secure and connect all the pipes and electrical connections.
- Refit the wheel and remove the stand from under the LH final drive casing.
- Fill up the fuel tank.
- Connect the battery negative lead.

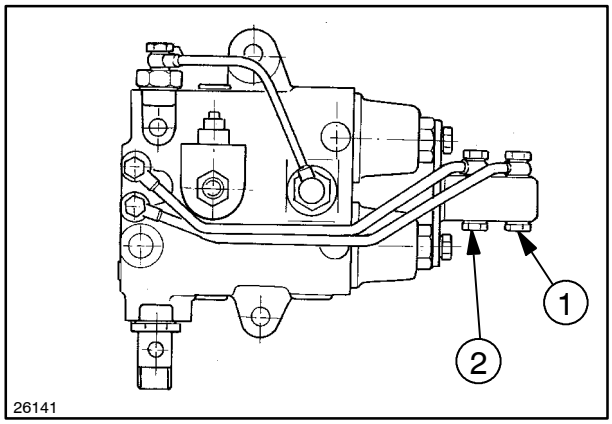


82

WORKING PRESSURE CHECK

Proceed as follows:

1. Start the engine and run the tractor in order to bring the oil in the rear the transmission-gear casing to a temperature of 122 to 140 °F (50 to 60 °C).
2. Switch off the engine, take off the cap (1), screw down the union **291318** (belonging to outfit **380000240**) and connect it, via the piping, to the pressure gauge with a scale of 0 to 25 kg/cm^2 in outfit **380000240**.
3. Start the engine, position the cursor on the Dual Command (2 Speed Power Shift) lever (13, page 15) in position (A) and check that the oil pressure is 227.72 to 242.22 psi (15.7 to 16.7 bar).
4. Check the other circuit after having removed plug (2), connected the pressure gauge and selected position (B) on the cursor on the Dual Command (2 Speed Power Shift) control lever (13, page 15).



83

NOTE: *Position (A) of the cursor on the lever (13, page 15) corresponds to LOW speed, position (B) of the cursor corresponds to HIGH speed, also remember that:*
the plug (1) corresponds to HIGH speed (18.64 mph (30 km/h version) or LOW speed (24.85 mph (40 km/h version) (front clutch);
the plug (2) corresponds to LOW speed (18.64 mph (30 km/h version) or HIGH speed (24.85 mph (40 km/h version) (rear clutch);
numbers (1 and 2) are stamped on the block next to the relative plugs.

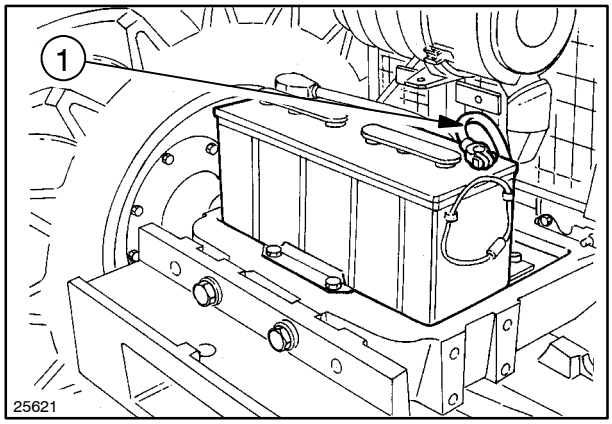
Op. 21 168 22
DUAL COMMAND (2 SPEED POWER SHIFT) CONTROL VALVE R.I.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

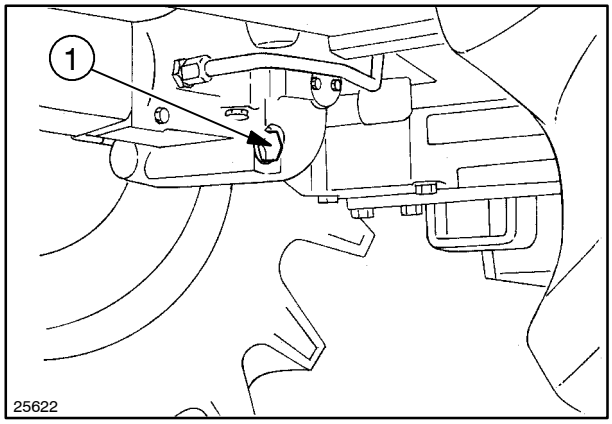
To remove the Dual Command (2 Speed Power Shift) control valve proceed as follows:

1. Disconnect the battery negative cable (1).



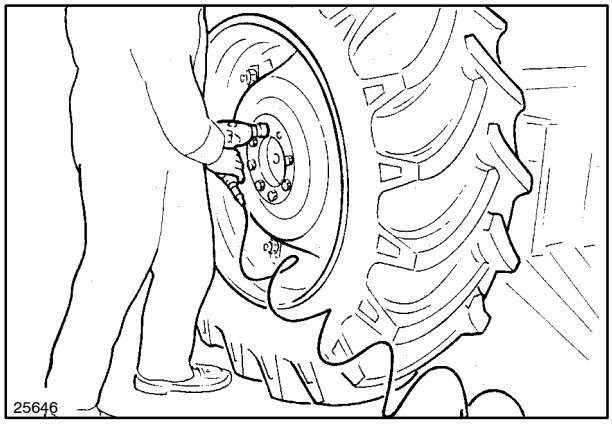
84

2. Take out the plug (1) and drain oil from the gear-box-transmission casing.



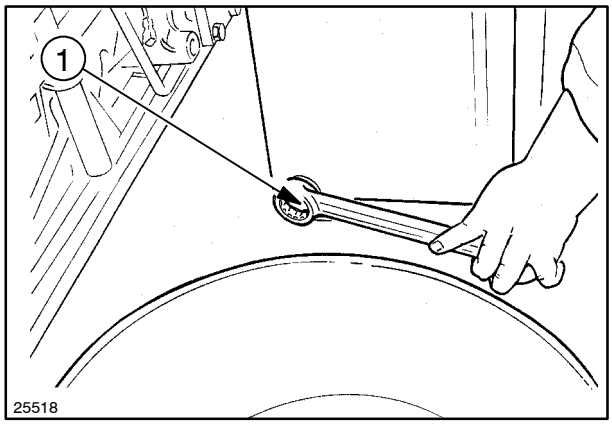
85

3. Insert a stand under the LH final drive casing and detach the wheel.



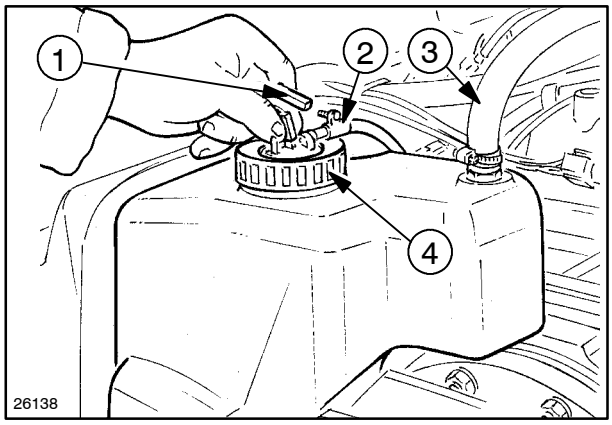
86

4. Remove the plug (1) and drain off the fuel tank into a suitable container (tank capacity is 29.05 gallons (110 litres).
5. Detach the window washer reservoir.



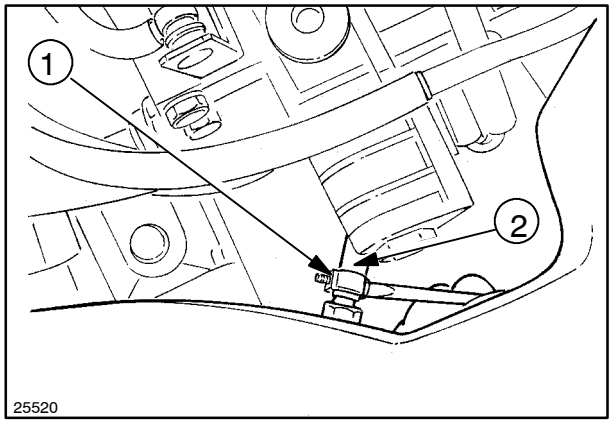
87

6. Disconnect the electrical connections (1) and the fuel return line located on the fuel gauge unit (4) and detach the breather pipe (3).



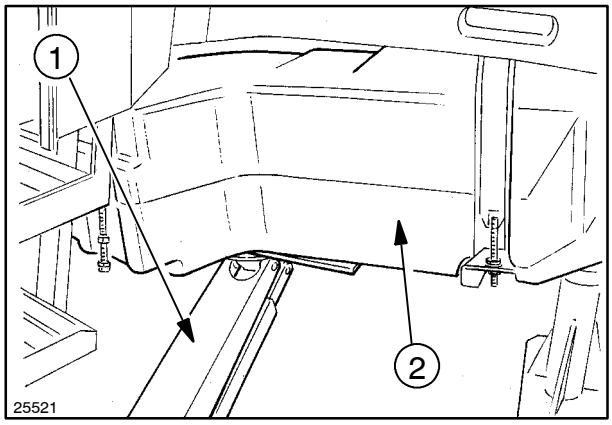
88

7. Take off the clamp (1) and remove the injection pump supply pipe (2).



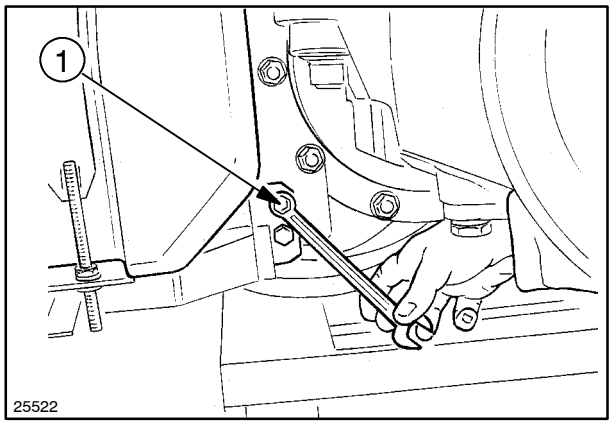
89

8. Position a hydraulic jack (1) under the central part of the tank (2) and slightly raise to facilitate disassembly operations.



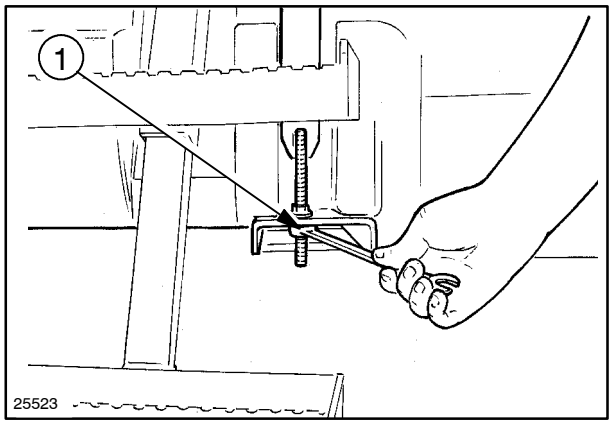
90

9. Take out the two bolts (1) retaining the rear bracket supporting the tank.



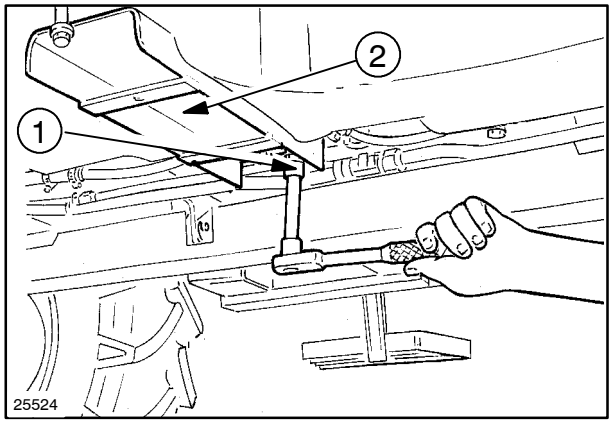
91

10. Unscrew the nut (1) securing the front clamp and repeat the operation on the rear clamp too.



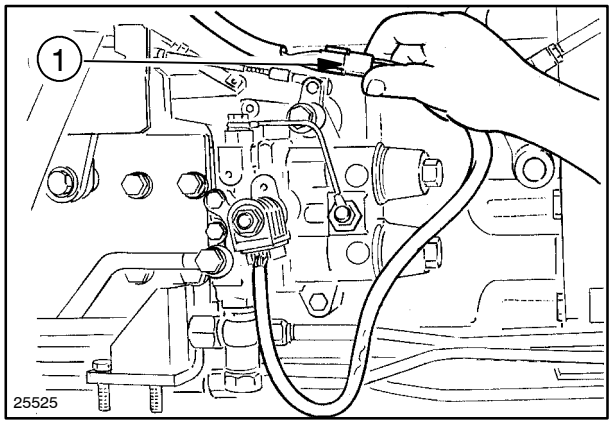
92

11. Take out the bolts (1) retaining the front bracket (2) and detach it, then lower the hydraulic lift and remove the fuel tank.



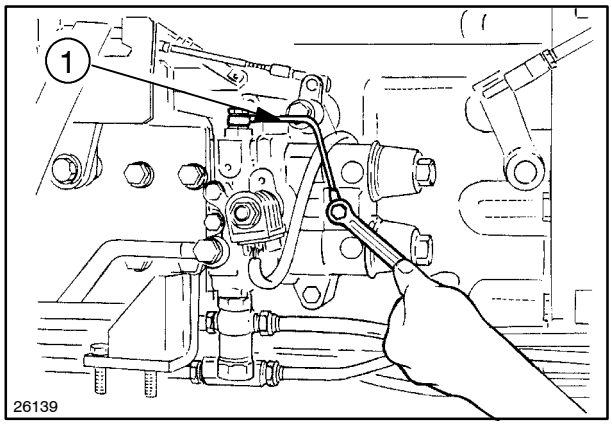
93

12. Detach the electrical connection (1) from the Dual Command (2 Speed Power Shift) solenoid valve.



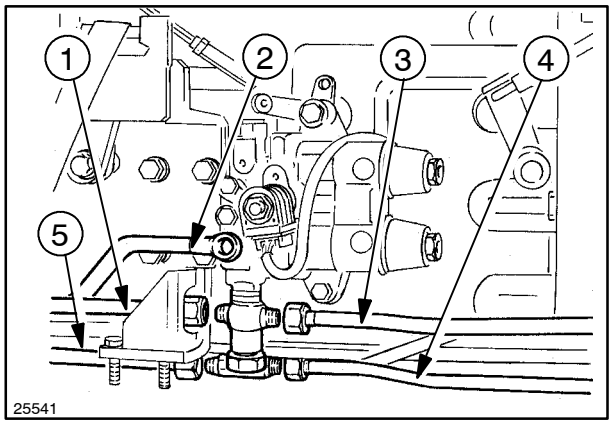
94

13. Detach the pipe (1) on the Dual Command (2 Speed Power Shift) control valve.



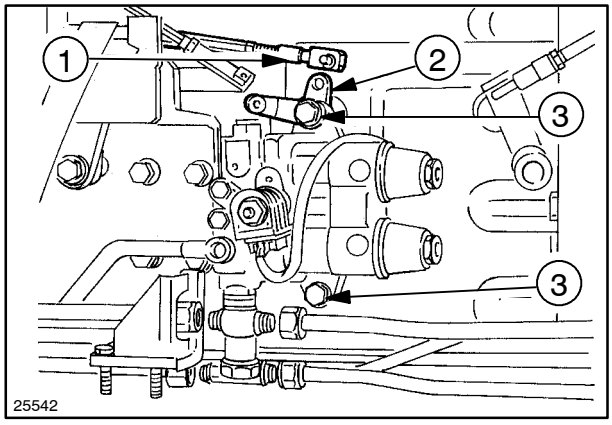
95

14. Unscrew the unions and detach the lines (1, 2, 3, 4 and 5) from the Dual Command (2 Speed Power Shift) control valve.



96

15. Detach the tie-rod (1) on the clutch discharge lever (2).
16. Take out the bolts (3) securing the control valve to the clutch casing and remove it.



97

17. To refit the Dual Command (2 Speed Power Shift) control valve to the clutch casing proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Assemble the Dual Command (2 Speed Power Shift) control valve.
- Fit the blow-by tube on the control valve.
- Connect the clutch discharge control lever tie-rod.
- Connect all the lines on the Dual Command (2 Speed Power Shift) control valve.
- Connect the Dual Command (2 Speed Power Shift) solenoid valve connection.
- Assemble the tank and connect all pipes and connections on the fuel gauge unit.
- Fit the LH rear wheel and extract the stand from under the LH final drive casing.
- Assemble the window washer reservoir.
- Fill up the gearbox-transmission casing with oil in the quantity described in **Section 00**.
- Fill up the fuel tank.
- Connect the battery negative lead.

Op. 21 168 23

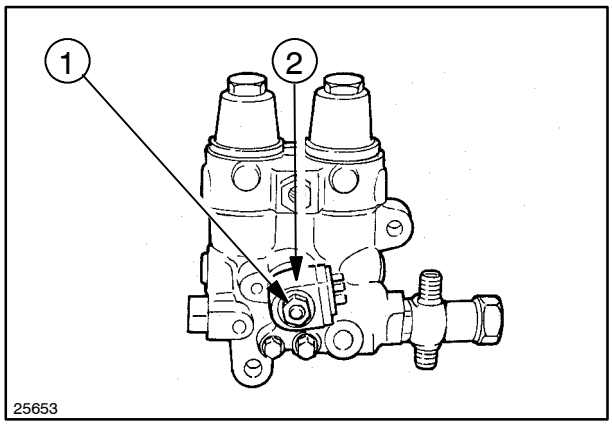
DUAL COMMAND (2 SPEED POWER SHIFT) CONTROL VALVE D.A.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

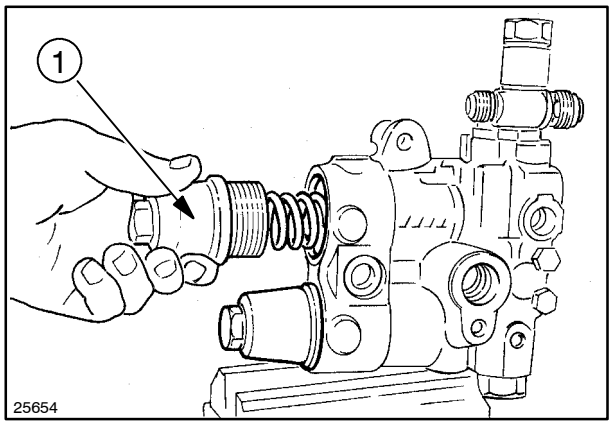
In order to work on the Dual Command (2 Speed Power Shift) control valve, it must be detached from the clutch casing following the operations described on page 41.

1. Position the control valve in a vice, unscrew the nut (1) and remove the Dual Command (2 Speed Power Shift) solenoid valve (2), complete with rod.



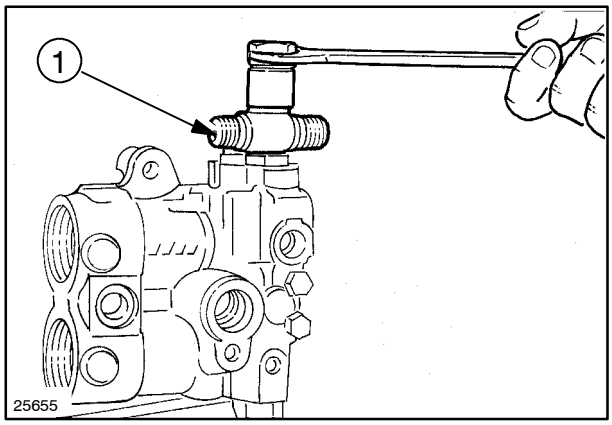
98

2. Remove the two accumulators (1) together with the relative springs and pistons.



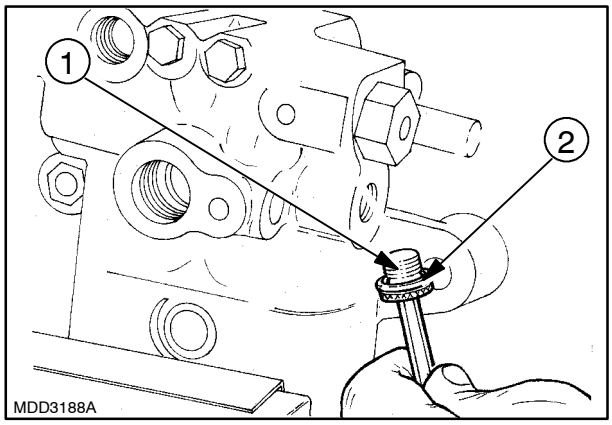
99

3. Unscrew the union (1) and remove the washer.



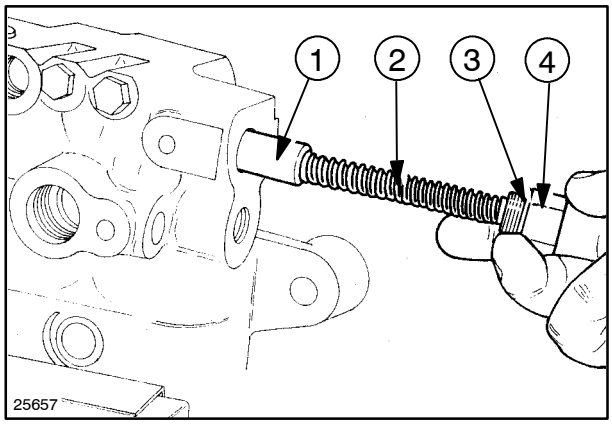
100

4. Unscrew the plug (1) with the washer (2). Carry out the same operation on the opposite side.



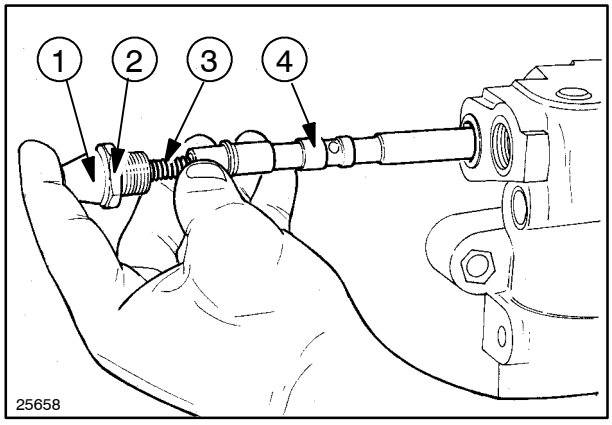
101

5. Remove the plug (4) with the washer (3), and disassemble the pressure control valve (1) and spring (2).



102

6. Remove the plug (1) with the washer (2), and disassemble the spring (3) and pressure release pin (4).



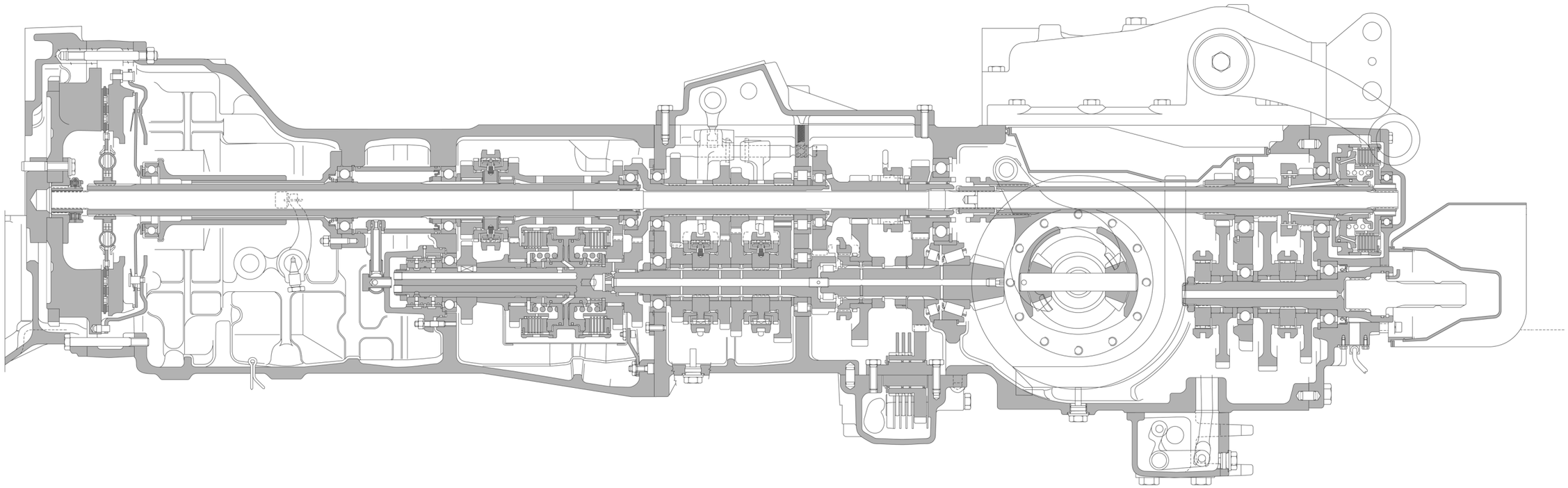
103

7. To assemble the Dual Command (2 Speed Power Shift) control valve proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Reverse the disassembly operations previously performed, starting from operation no. 6 to no. 1.
- Refer to the illustrations in fig. 4 for the positioning of the various parts.
- Make sure that all parts are clean.
- Check the seals and replace if damaged.



MDD3189A

104

Longitudinal section of the transmission with hydraulic PTO and Dual Command (2 Speed Power Shift) (18.64 mph (30 km/h) version)

SECTION 21 - TRANSMISSIONS

Chapter 5 - Reverser and creeper unit

CONTENTS

Operation	Description	Page
	Data	2
	Tightening Torques	3
	Tools	4
	Cross-sectional views	6
	Description and Operation	8
	Fault diagnosis	8
21 110 87	Reverser-clutch casing and creeper unit D.A.	9

REVERSER DATA

Type	mechanical type with spur gearing, located between the main clutch and the gearbox. Composed of no. 1 driving gear, no. 1 intermediate gear and no. 1 intermediate gear.
Operating	with hand lever located on left-hand side of operator

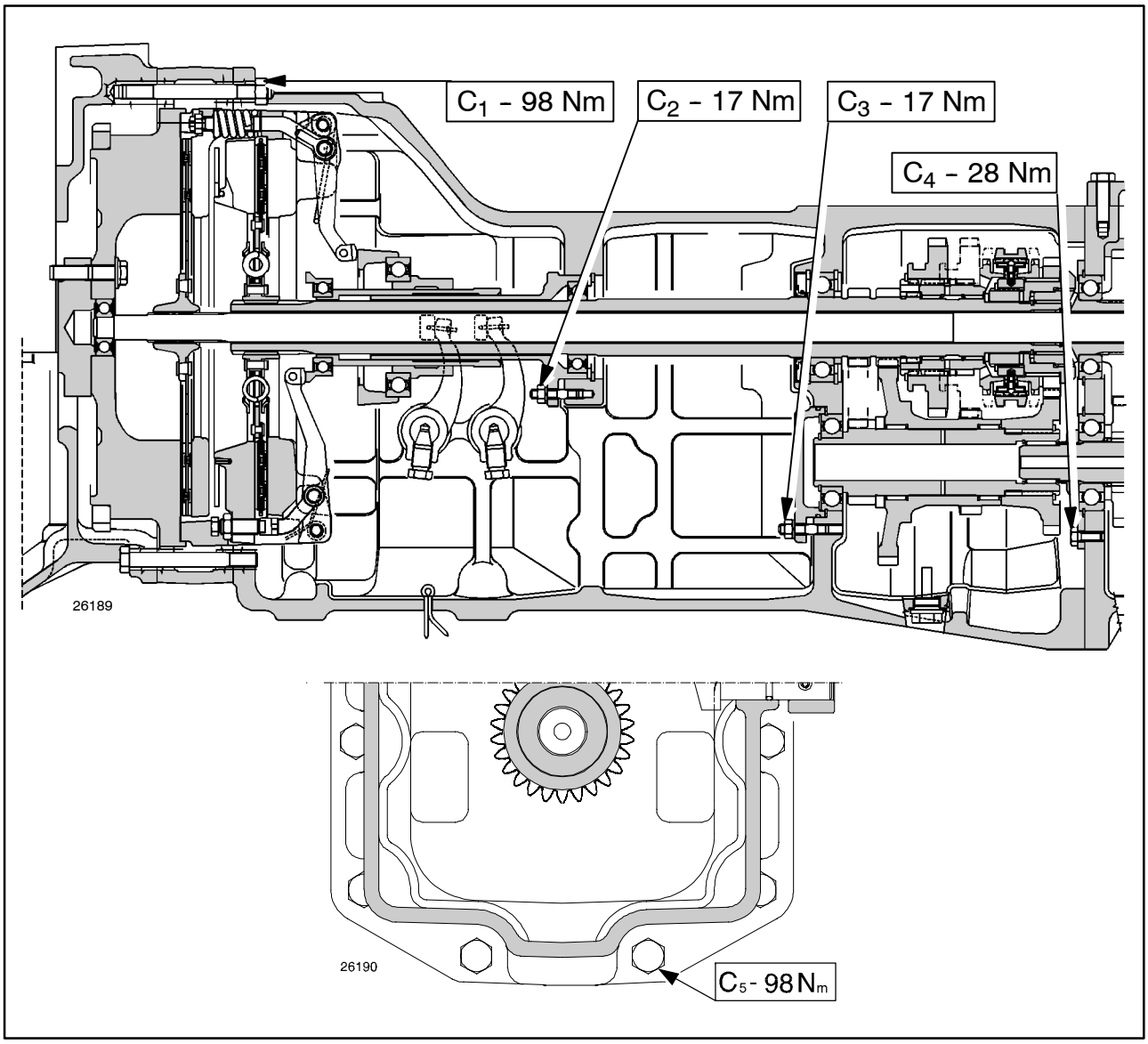
CREEPER UNIT DATA

Type	Cascading with spur gearing, located between the main clutch and the gearbox, in series with the reverser. Providing 20 forward gears and 12 reverse gears
Gear ratio	$\frac{18x26}{55x47}$ = 1:5.524
Operating	with lever located on right-hand side of operator

TRANSMISSION DATA

Gearbox	4 speed, constant-mesh, with synchronisers on all gears
Gearing type	helical
Reducer	ordinary gear train with 3 ranges providing a total of 12 gears
- gearing type	spur
- reduction ratios:	
• low	$\frac{23x17}{43x50}$ = 1:5.49
• intermediate	$\frac{23x27}{43x34}$ = 1:2.35
• high	1
Gearbox and range gear operating system	independent, by means of two levers located on right-hand side of operator

For missing data see Chapter 1



1

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Bolts or nuts securing reverser-clutch casing and creeper unit to the engine (C_1)	M 12 x 1.25	98	10
Sleeve cover nuts (C_2)	M 8 x 1.25	17	1.7
Reverser-creeper driven shaft cover retaining nuts (C_3)	M 8 x 1.25	17	1.7
Gearbox driving and driven shafts bearing cover screws (C_4)	M 8 x 1.25	28	2.9
Creeper and reverser-clutch casing/rear transmission-gearbox casing retaining bolt (C_5)	M 12 x 1.25	98	10

TOOLS

WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**.

To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

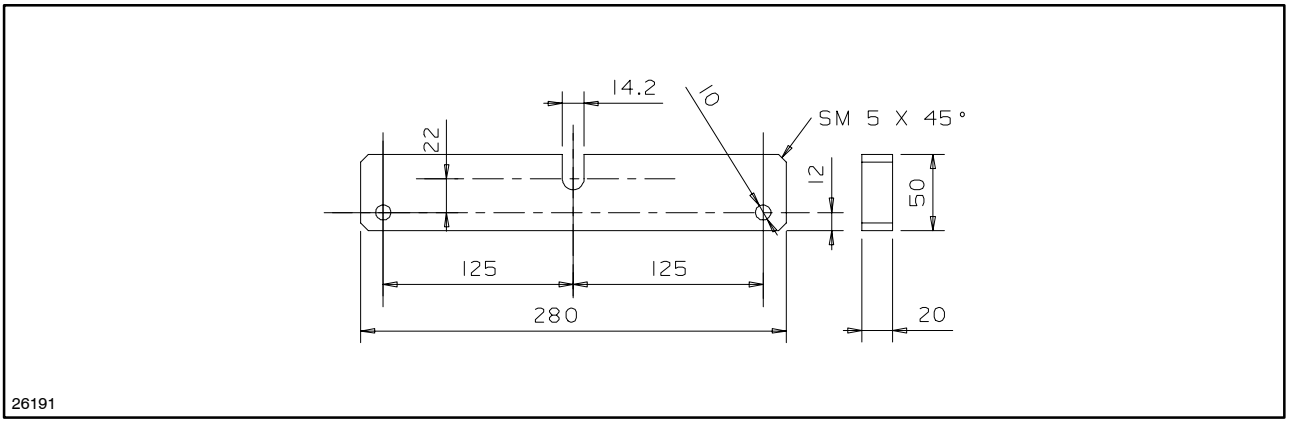
380000236 Tractor disassembly trolley.

380000227 Clutch casing lift hook.

380000301 Rotating stand for overhaul operations.

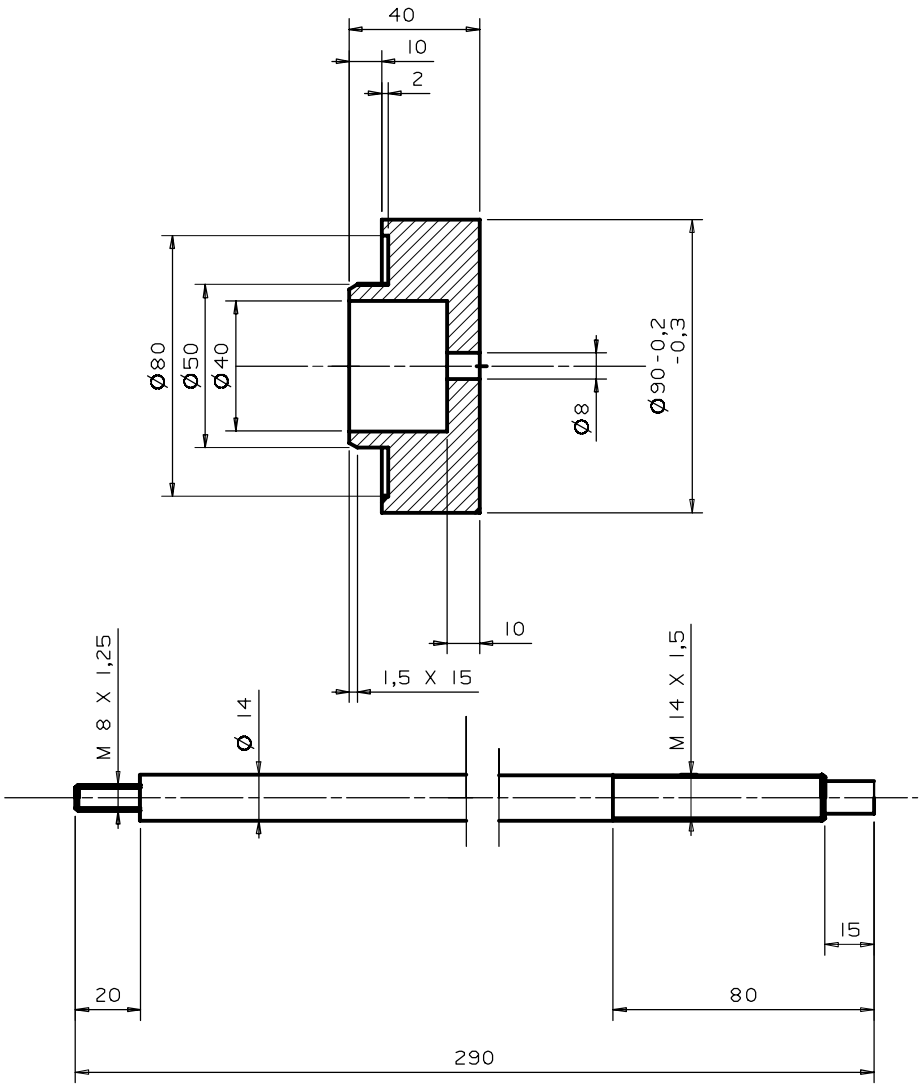
380000271 Front bracket (with **380000301**).

380000272 Rear bracket (with **380000301**).



2

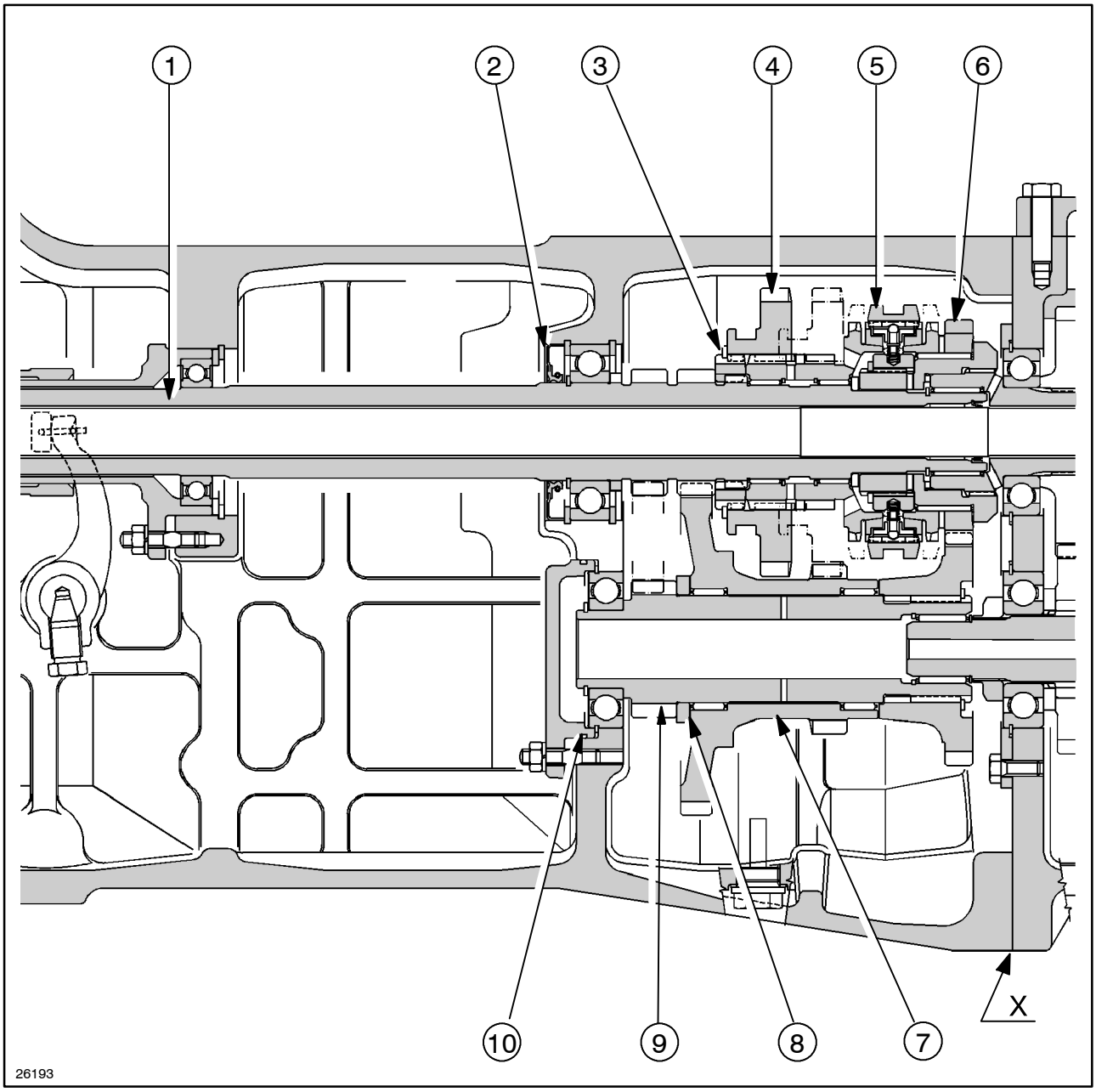
Support bracket for fitting the transmission driving shaft seal (mark tool with no. 50043) (Measurements in mm).
Make in UNI C40 material.



26192

3

Striker for transmission driving shaft seal assembly (mark tool with no. 50137) (Measurements in mm)
Make in UNI C40 material.

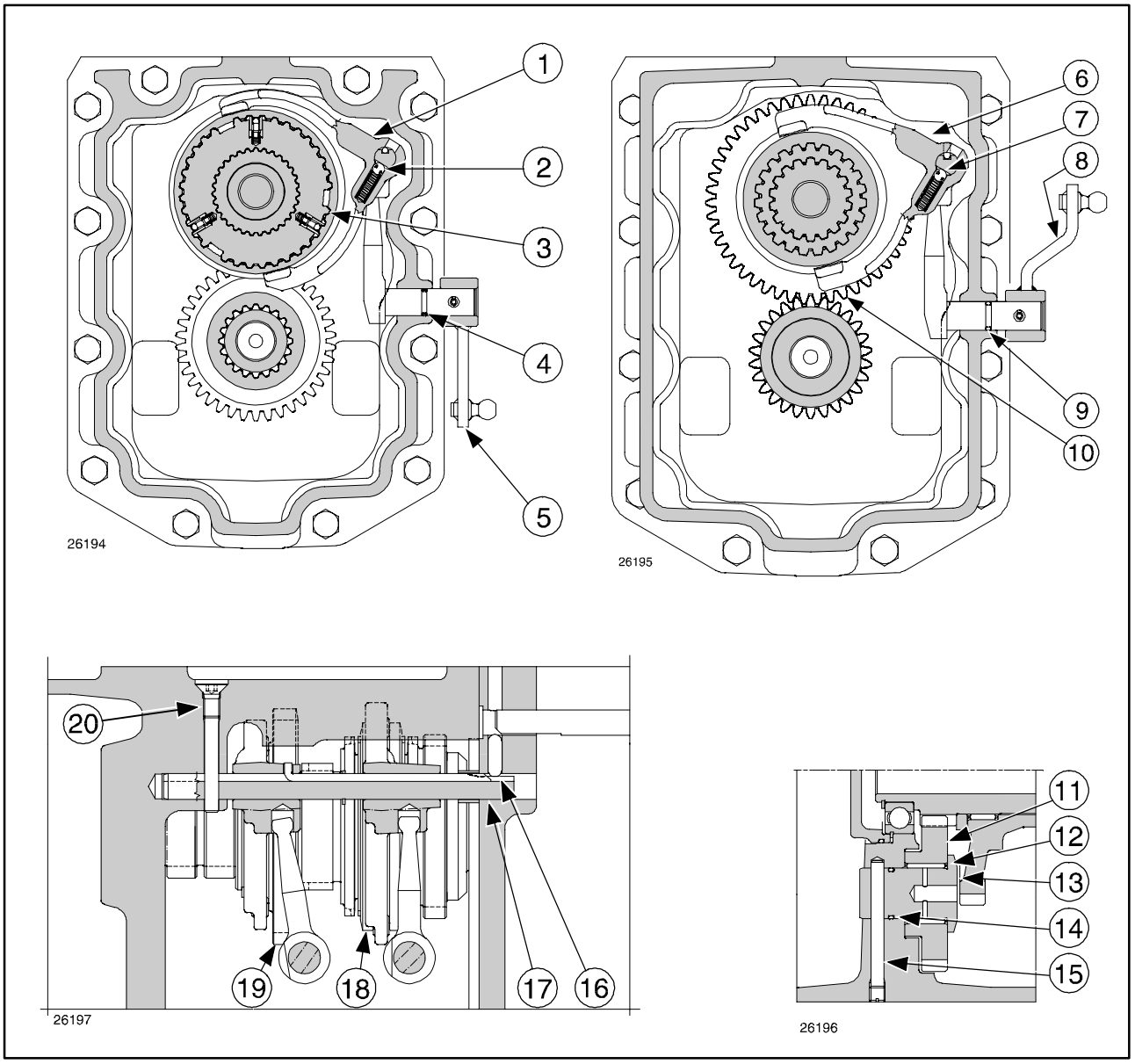


4

Longitudinal section of reverser-creeper

1. Reverser and creeper shaft.
2. Seal.
3. Retaining snap ring.
4. Creeper gear unit.
5. Reverser-creeper synchroniser.
6. Reverser-driven shaft gear unit.
7. Creeper unit driven gear.
8. Thrust washer.
9. Reverser driven shaft.
10. Seal.

NOTE: *On assembly apply a bead of sealing compound to the surfaces* ***X*** *as indicated on page 26, chap. 4.*



5

Cross-sectional views of reverser-creeper

1. Reverser control fork.
2. Poppet ball.
3. Reverser control synchroniser.
4. Seal.
5. Reverser control external lever.
6. Creeper fork.
7. Poppet ball.
8. Creeper unit external control lever.
9. Seal.
10. Creeper gear unit.
11. Reverser intermediate gear.
12. Needle bearing.
13. Gear journal (11).
14. Seal.
15. Pin retaining bolt (13).
16. High gears pawl.
17. Reverser and creeper control rod.
18. Reverser control synchroniser.
19. Creeper gear unit.
20. Rod retaining bolt (17) (the bolt must be smeared with one of the sealing compounds listed in **Section 00**.

DESCRIPTION AND OPERATION

The reverser-creeper unit is a mechanical device providing 20 forward speeds and 12 reverse speeds.

The creeper unit only intervenes in slow and medium slow ranges, a mechanical interlock prevents creeper engagement in the fast ranges.

The creeper unit is composed of a group of three spur gears: a sliding control gear, a synchroniser control gear and a driven gear. The synchroniser is the same for the reverser.

The creeper unit is installed in series with the reverser and is controlled by a lever located on the right-hand side of the operator.

The reverser is composed of a group of three spur gears: reverser driving gear, intermediate gear and driven gear. Selection is effected by means of a synchroniser located in the gear unit.

The reverser-creeper unit is installed inside the clutch casing, between the clutch and the gearbox.

Lubrication is by means of the oil in the rear transmission casing/gearbox.

REVERSER-CREEPER TROUBLESHOOTING

Problems	Possible Causes	Solutions
Spontaneous reverser-creeper disengagement.	**1.** External levers and relay rods incorrectly adjusted.	Adjust correctly.
	2. Synchroniser teeth damaged.	Remove the clutch casing and replace the synchroniser.
	3. Engagement stroke incomplete.	Eliminate the cause and reset the complete stroke.
The reverser-creeper engages with difficulty.	**1.** External levers and relay rods incorrectly adjusted.	Adjust correctly.
	2. Stiffness and/or seizure of external levers and rods.	Check rod pivots and lubricate.
	3. Main clutch dragging.	See page 5, sect. 18.
	4. Synchroniser damaged.	Remove the clutch casing-gearbox and replace the synchroniser.
	5. Internal controls do not slide easily: rods, forks and sleeves.	Overhaul the controls.
The reverser-creeper is noisy.	**1.** Worn or damaged internal parts.	Remove the clutch casing and replace the damaged parts.

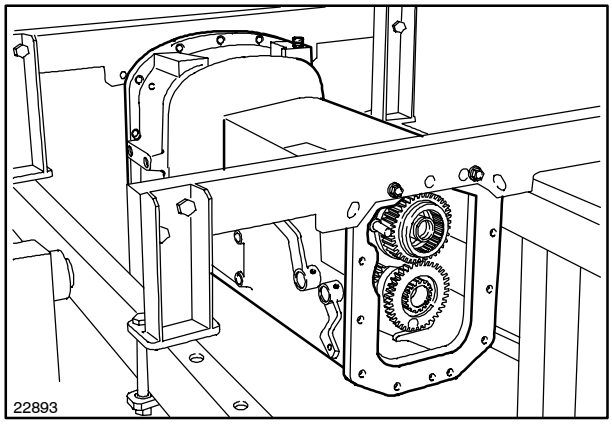
Op. 21 110 87
REVERSER-CLUTCH CASING AND CREEPER UNIT
Replacement

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

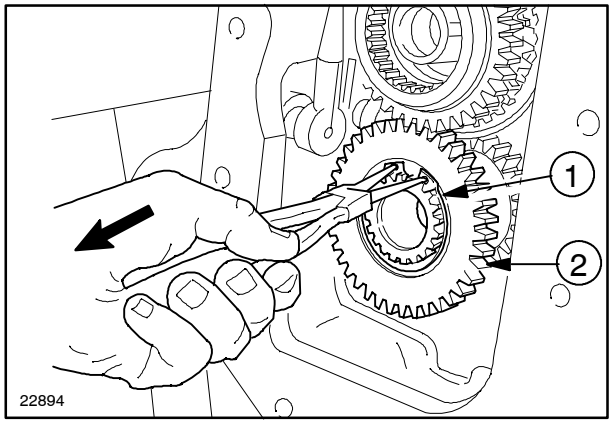
In order to work on the reverser-creeper unit first detach the cab or platform as described in Section 90 and remove the clutch casing as described in 4. Then proceed as follows:

1. Position the casing on the rotating stand **380000301** using the brackets **380000271** and **380000272**.



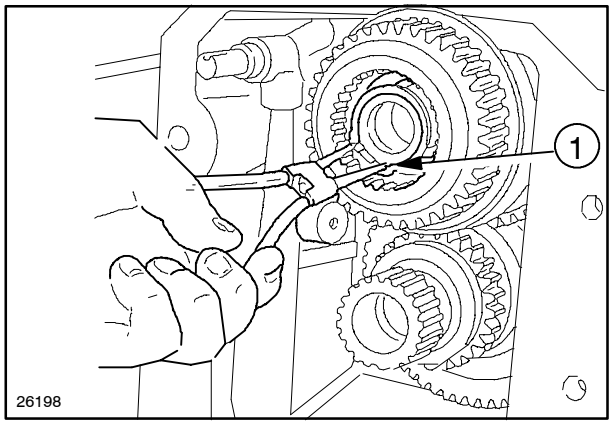
6

2. Remove the snap ring (1) and extract the gear unit (2).



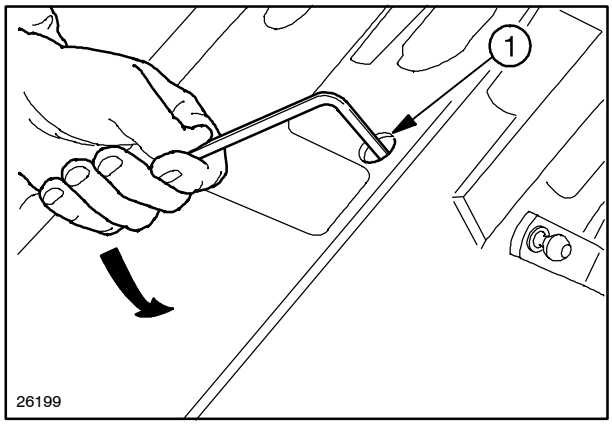
7

3. Remove the circlip (1).



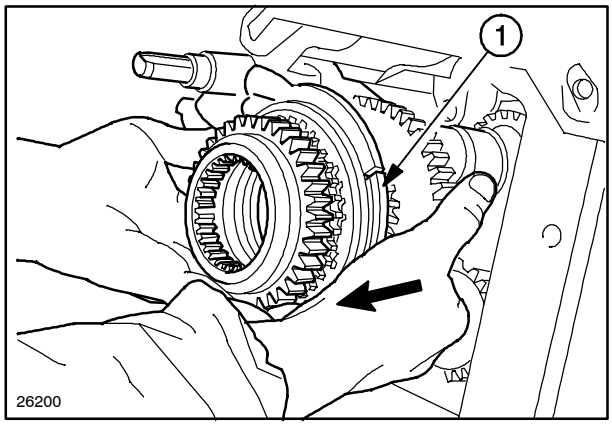
8

4. Remove the fork sliding rod retaining bolt (1).



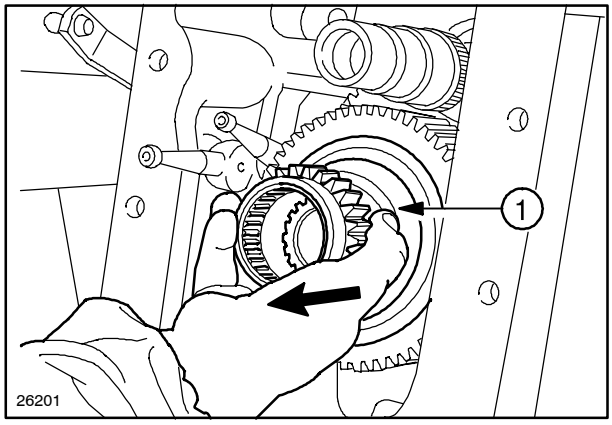
9

5. Remove the synchroniser unit (1) together with the sliding rod, forks and gears.



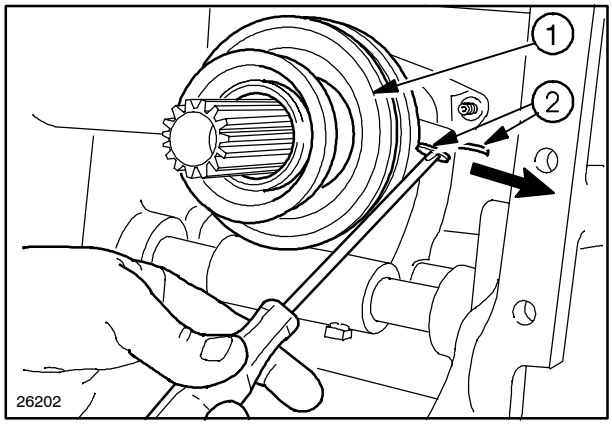
10

6. Extract the gear unit (1) and the roller bearings then remove the thrust washer.



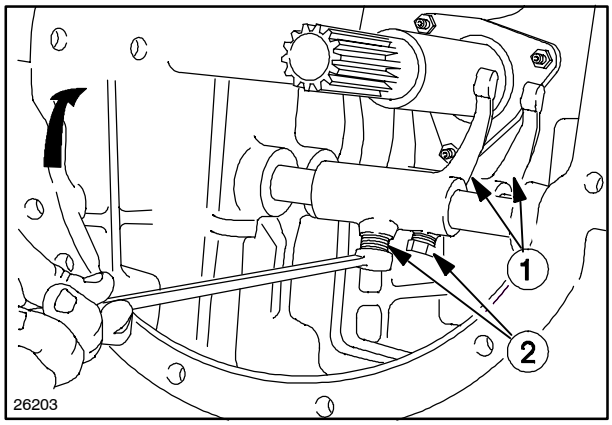
11

7. Working from the opposite side of the casing, remove the retaining clips (2) and extract the clutch pressure plate bearing unit (1).



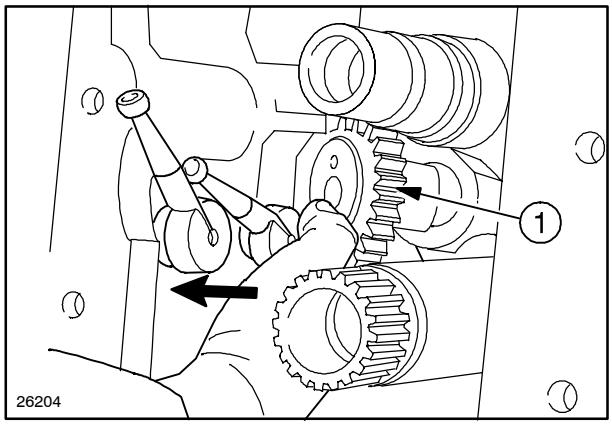
12

8. Take out the retaining bolts (2) and the forks (1).



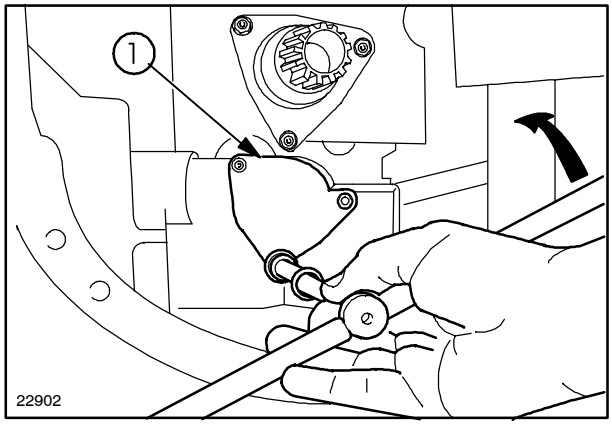
13

9. Take out the retaining bolt (15, fig. 5) and extract the reverser intermediate gear unit (1).



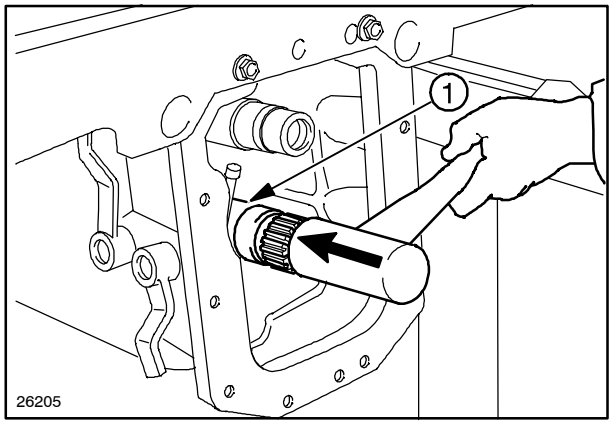
14

10. Remove the nuts, washers and cover (1).



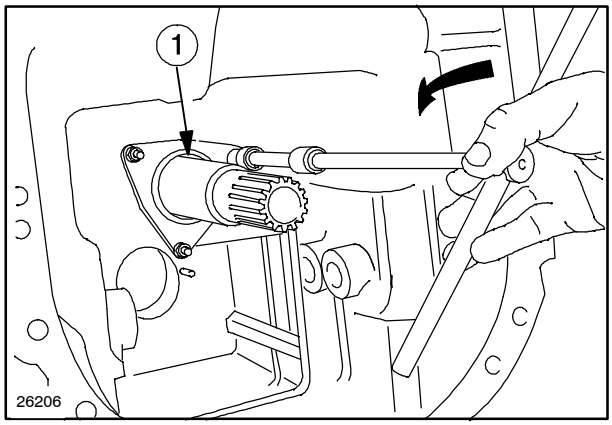
15

11. Working from the rear remove the snap ring and shaft (1) with relative bearing.



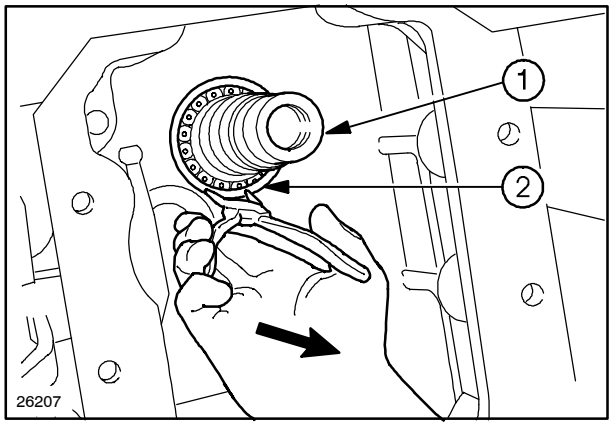
16

12. Remove the nuts and washers and the clutch sleeves support (1), together with the bearing.



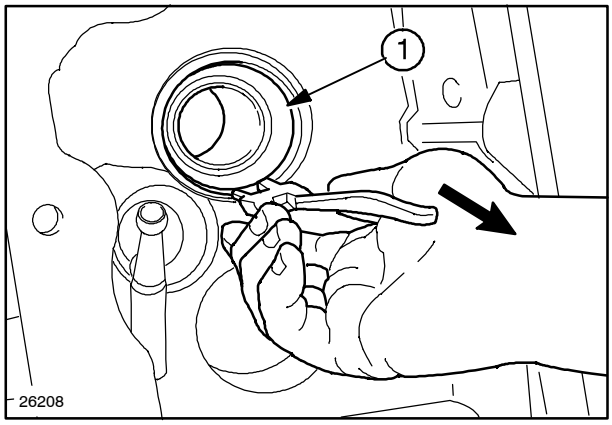
17

13. Take off the circlip (2) and remove the shaft (1) together with the bearing.



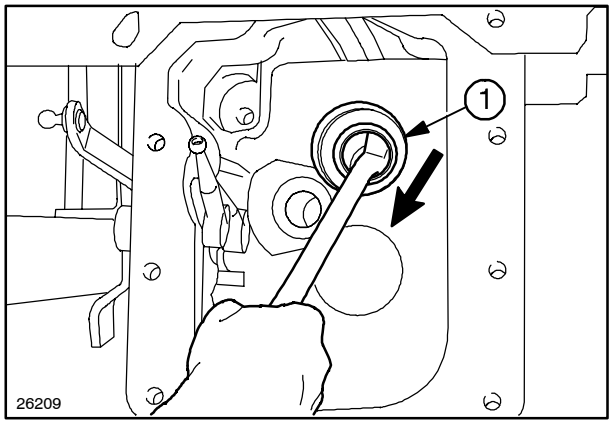
18

14. Take off the circlip (1) left in its seat.



19

15. Using a suitable tool, extract the seal (1).



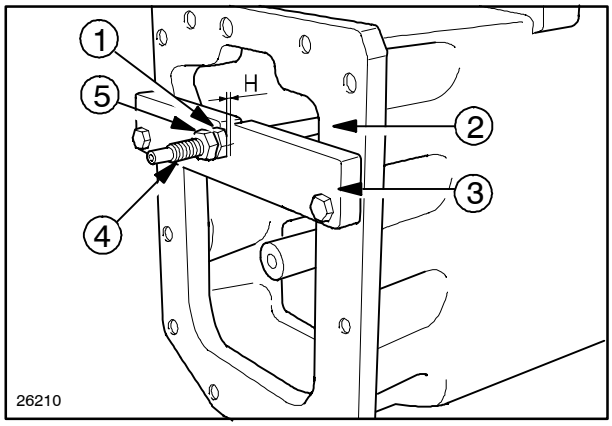
20

16. To refit all the reverser and creeper parts in the casing proceed as follows:

CAUTION

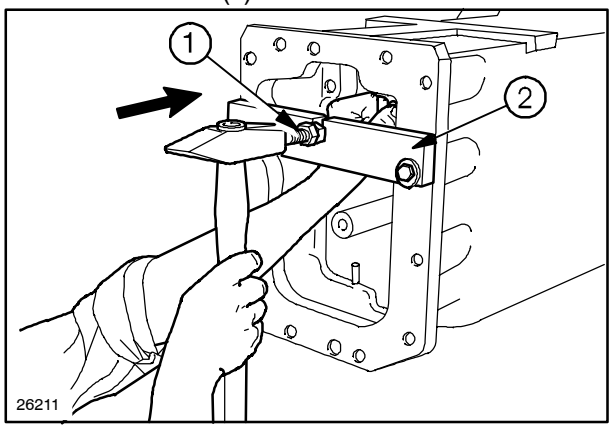
Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Study the illustrations in figs. 4 and 5 for the positioning of the various parts.
- Respect the tightening torques prescribed on page 3.
- To fit the seal (1, fig. 20) follow operations 17. to 24.
- Assemble the drive shaft, complete with bearing and circlips.
- Fit the snap ring in the sleeve support, position the spacer then fit the clutch sleeve support–cover.
- Assemble the reverser and creeper driven gear unit shaft.
- Fit the driven gear shaft cover and secure in position with the bolts.
- Assemble the reverser intermediate gear unit and secure with the relative bolt.
- Fit and secure the clutch forks to the relative levers.
- Assemble the pressure plate bearings and secure with relative clips.
- Assemble the driven gear unit, bearing and thrust washer.
- Assemble the synchroniser unit and all gears and forks then secure in position with the circlip.
- Fit the rod retaining bolt smearing the thread with one of the sealing compounds listed in Section 00.
- Assemble the gear on the reverser driven shaft and secure with the circlip.
- Remove the clutch–reverser and creeper casing from stand **380000301**.



21

17. Fit the circlip, seal side (1, fig. 19), in its seat.
18. Make the bracket for tool **50043** (3, fig. 21) and striker **50137** (4, also see figs. 2 and 3).
19. Fit the bracket (3) on the clutch casing (2), insert the striker (4, see fig. 3) in the seal seat touching the circlip (1, fig. 19).
20. Tighten the nut (1, fig. 21) until the distance (H) between the bracket and the nut is 0.1299 to 0.1417 in. (3.3 to 3.6 mm) then secure the nut with a locknut (5).

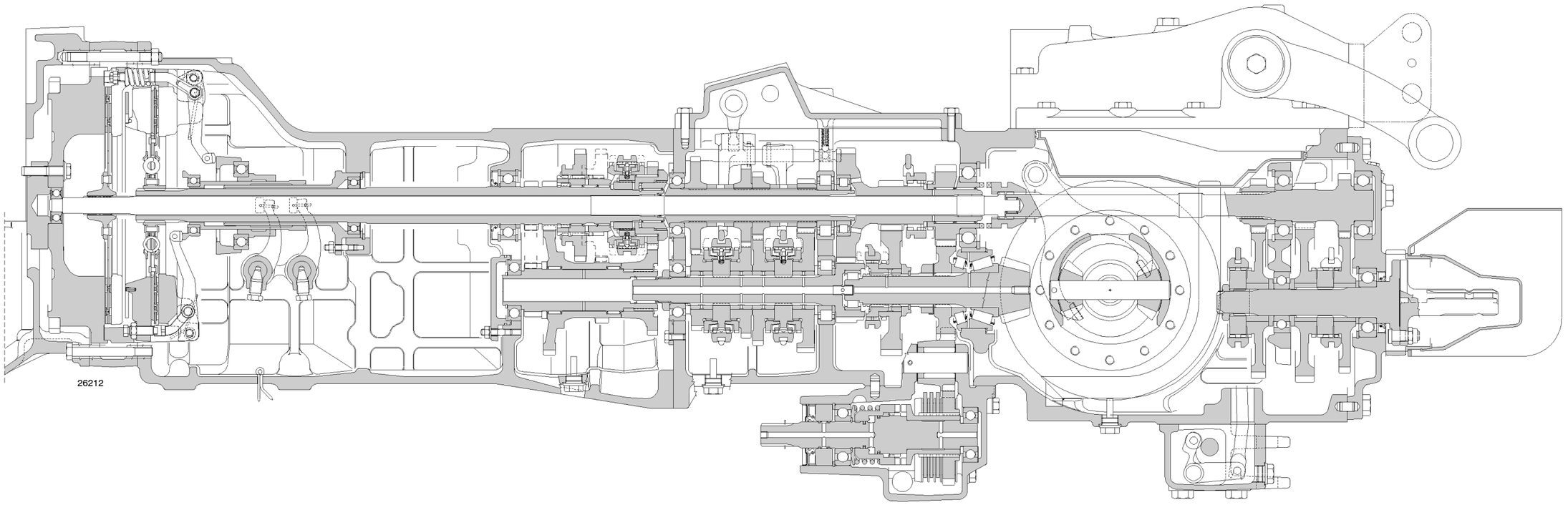


22

21. Extract the punch (1), remove the bracket (2) and the circlip (1, fig. 19).
22. Insert a new seal (2, fig. 4), in its seat, fit the bracket (2, fig. 22) back on the clutch casing and insert the punch (1) on the bracket.
23. Force the seal in until the nut (1, fig. 21) is fully up against the bracket (2).
24. Remove the bracket (2), extract the punch (1) and then proceed to assemble the other parts.

NOTE: *Leave the striker (1) and nut in this position even when replacement operations are terminated.*

For future replacements just check that the distance (H, fig. 21) is as prescribed.



Longitudinal section of the reverser and creeper

23

SECTION 21 - TRANSMISSIONS

Chapter 6 - Power Shuttle transmission with Dual Command (2 Speed Power Shift) function

CONTENTS

Operation	Description	Page
	Data	2
	Tightening Torques	4
	Tools	6
	Cross-sectional views	8
	Description and Operation	11
21 110 88	Clutch casing with Power Shuttle and Dual Command (2 Speed Power Shift) units D.A.	18
21 154 60	Clutch (A) D.A.	25
	Clutch (B) D.A.	27
	Fault code decoding	28
	Calibrations	29
	First start-up procedure	48
	Diagnostics	49

TRANSMISSION DATA

Gearbox	4 speed, constant-mesh, with synchronisers on all gears
Gearing type	helical
Reducer	ordinary gear train with 3 ranges providing a total of 12 gears
Gearing type	spur
Gearbox and range gear operating system	independent, by means of two hand levers located on the right-hand side of the operator

POWER SHUTTLE AND DUAL COMMAND (2 SPEED POWER SHIFT) DATA

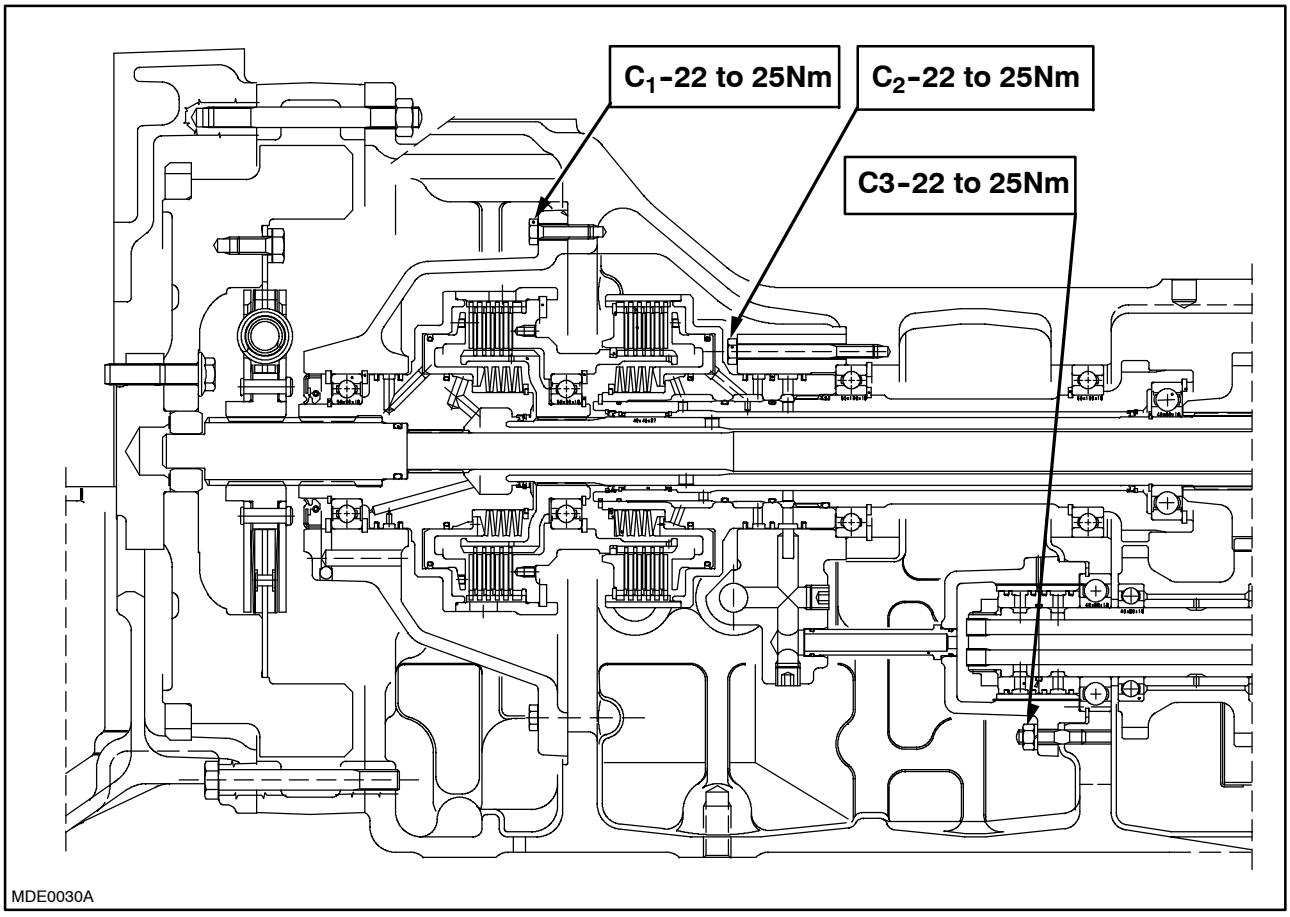
Hydraulic control valve		mounted on the outer left-hand side of the clutch casing, comprising: - no. 4 solenoid valves; - one pressure control valve; - no. 1 accumulator; - no. 4 unions for checking the pressure of the various clutches.
Power Shuttle gears and services working pressure	psi (bar)	227.72 to 242.22 (15.7 to 16.7)
Accumulator		with diaphragm
By-pass valve spring (18, fig. 7):		
- spring free length	in. (mm)	0.8070 (20.5)
- spring length under load of 41.2 to 45.2 N (4.2 to 4.6 kg)	in. (mm)	0.6299 (16)
Mating clearance between:		
- pressure control valve and relative seat on hydraulic control valve	in. (mm)	0.0029 to 0.0013 (0.025 to 0.035)
Pressure control valve spring (15, fig. 7):		
- spring free length	in. (mm)	5 (127)
- spring length under load of 279 to 304 N (28.5 to 31 kg)	in. (mm)	4.0354 (102.5)
Power Shuttle transmission lubrication pressure	psi (bar)	42.06 to 53.66 (2.9 to 3.7)
Lubrication pressure control valve spring (1, fig. 6):		
- spring free length	in. (mm)	1.4960 (38)
- spring length under load of 29 to 31 N (3 to 3.2 kg)	in. (mm)	0.9645 (24.5)
Filter		paper cartridge
Location		fixed to the pump housing on suction side

(continued)

(cont)

Pump		the same as used for the hydrostatic steering system (see Section 41)
Power Shuttle unit		to reverse without having to stop the tractor or use the clutch pedal
Operating		by means of hand lever located under the steering wheel, to the left-hand side of the operator
Number of driven plates in each clutch	no.	5
Thickness of driven plates	in. (mm)	0.1043 to 0.1082 (2.65 to 2.75)
Driven plate material		N 401-2
Number of driving plates in each clutch	no.	5
Thickness of driving plates	in. (mm)	0.0846 to 0.0885 or 0.0925 to 0.0964 (2.15 to 2.25 or 2.35 to 2.45)
Driving plate material		steel
Thickness of clutch assembly under a load of 1600 N (163.1 kg)	in. (mm)	0.9960 to 1.0039 (25.3 to 25.5) (1)
Power Shuttle clutch pistons return spring (11, fig. 5):		
- number of springs for each clutch	no.	7
- spring free height	in. (mm)	0.1653 (4.2)
- spring height under a load of 2108 N (215 kg)	in. (mm)	0.1299 (3.3)
Dual Command (2 Speed Power Shift)		provides two speeds (HIGH and LOW) within the same gear. The two speeds can be engaged under load by means of two clutches in oil baths.
Operating		by means of push-buttons located on the gear lever
Number of driven plates in each Dual Command (2 Speed Power Shift) clutch	no.	5
Driven plate thickness	in. (mm)	0.0688 to 0.0728 or 0.0767 to 0.0807 (1.75 to 1.85 or 1.95 to 2.05)
Driven plate material		steel
Number of driving plates in each Dual Command (2 Speed Power Shift) clutch	no.	5
Thickness of driving plates	in. (mm)	0.0767 to 0.0807 (1.95 to 2.05)
Driving plate material		N 401-4-20
Thickness of clutch assembly under a load of 1600 N (163.1 kg)	in. (mm)	0.7519 to 0.7598 (19.1 to 19.3) (1)
Dual Command (2 Speed Power Shift) clutch pistons return springs (9, fig. 5):		
- length of free springs	in. (mm)	2.4015 (61)
- length of springs under load of 954 to 1052 N (97.3 to 107.3 kg)	in. (mm)	1.3385 (34)

(1) Value to obtain by varying the thickness of the driving plates.

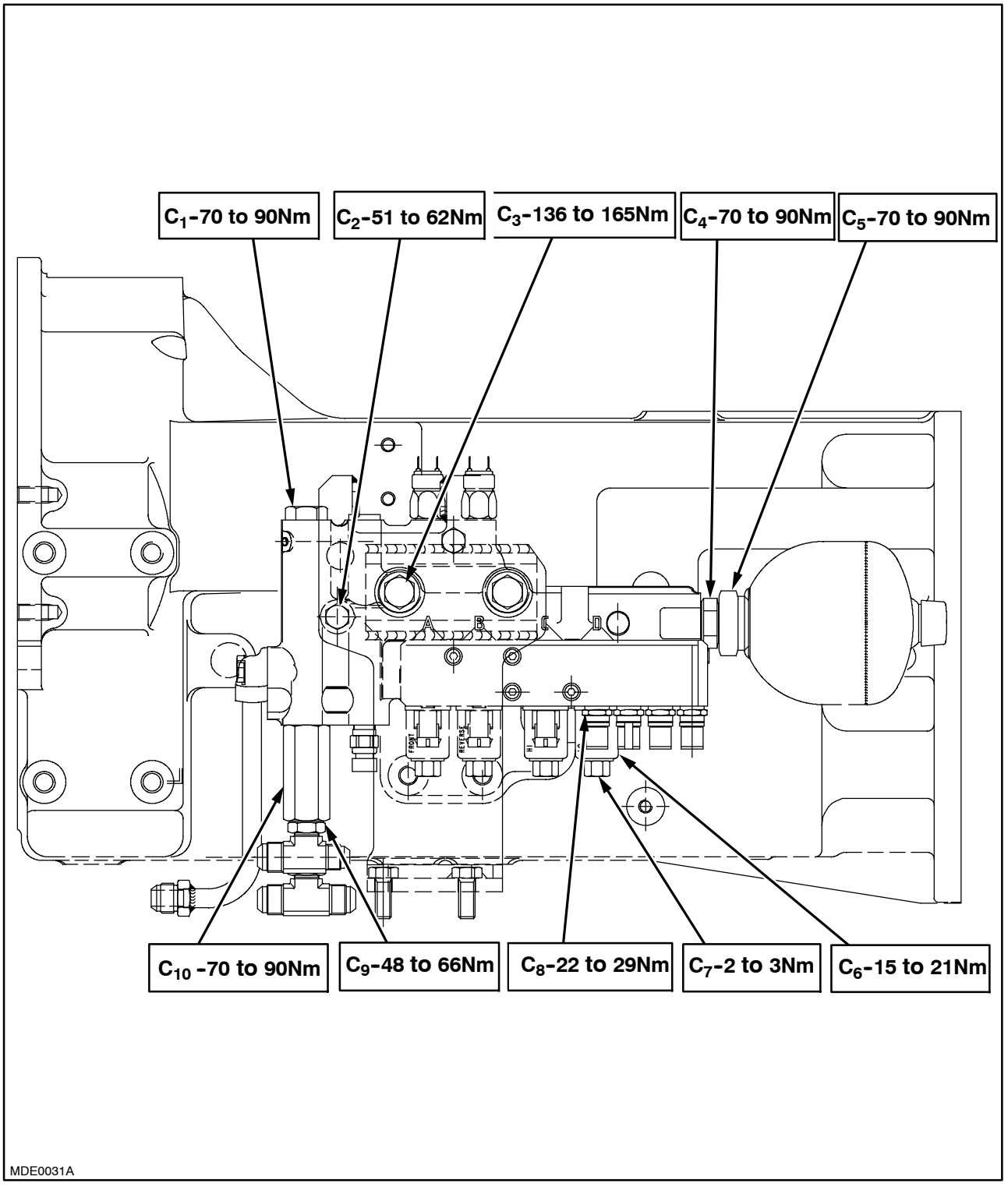


1

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
For missing data see Chapter 1			
Clutch A cover retaining screw (C_1, fig. 1)	–	22 to 25	2.24 to 2.55
Lubrication manifold retaining screw (C_2)	–	22 to 25	2.24 to 2.55
Driven shaft manifold cover retaining nut (C3)	–	22 to 25	2.24 to 2.55
Control valve cap (C_1, fig. 2)	–	70 to 90	7.1 to 9.2
Control valve retaining screw (C_2)	–	51 to 62	5.2 to 6.3
Control valve retaining screw (C_3)	–	136 to 165	13.9 to 16.8
Accumulator union (C_4)	–	70 to 90	7.1 to 9.2
Accumulator (C_5)	–	70 to 90	7.1 to 9.2
Solenoid valve pin retaining screw (C_6)	–	15 to 21	1.53 to 2.14
Solenoid valve retaining screw (C_7) (•)	–	2 to 3	0.2 to 0.3
Clutch pressure control union (C_8)	–	22 to 29	2.24 to 3
Oil delivery T union (C_9)	–	48 to 66	4.9 to 6.7
Oil delivery union (C_{10})	–	70 to 90	7.1 to 9.2

(•) Apply 1 or 2 drops of LOCTITE 542 before tightening.

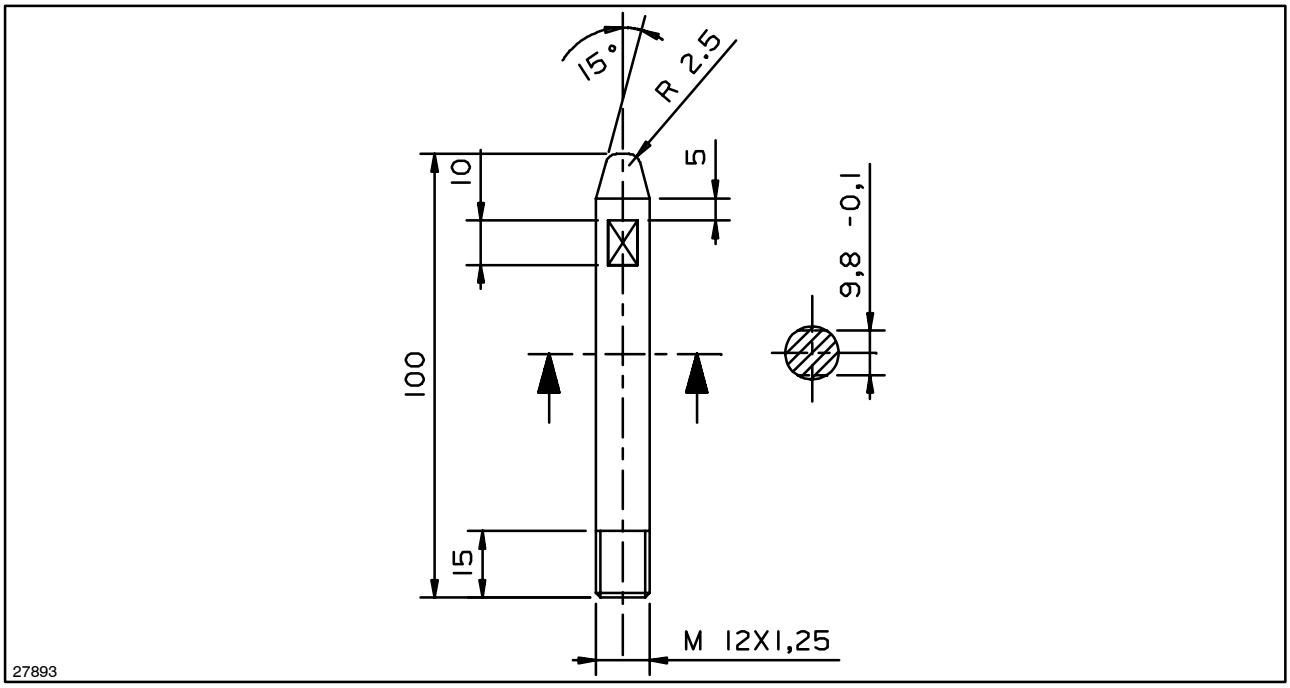

C1-70 to 90Nm
C2-51 to 62Nm
C3-136 to 165Nm
C4-70 to 90Nm
C5-70 to 90Nm
A
B
C
D
FRONT
REVERSE
C10 -70 to 90Nm
C9-48 to 66Nm
C8-22 to 29Nm
C7-2 to 3Nm
C6-15 to 21Nm
MDE0031A

2

TOOLS

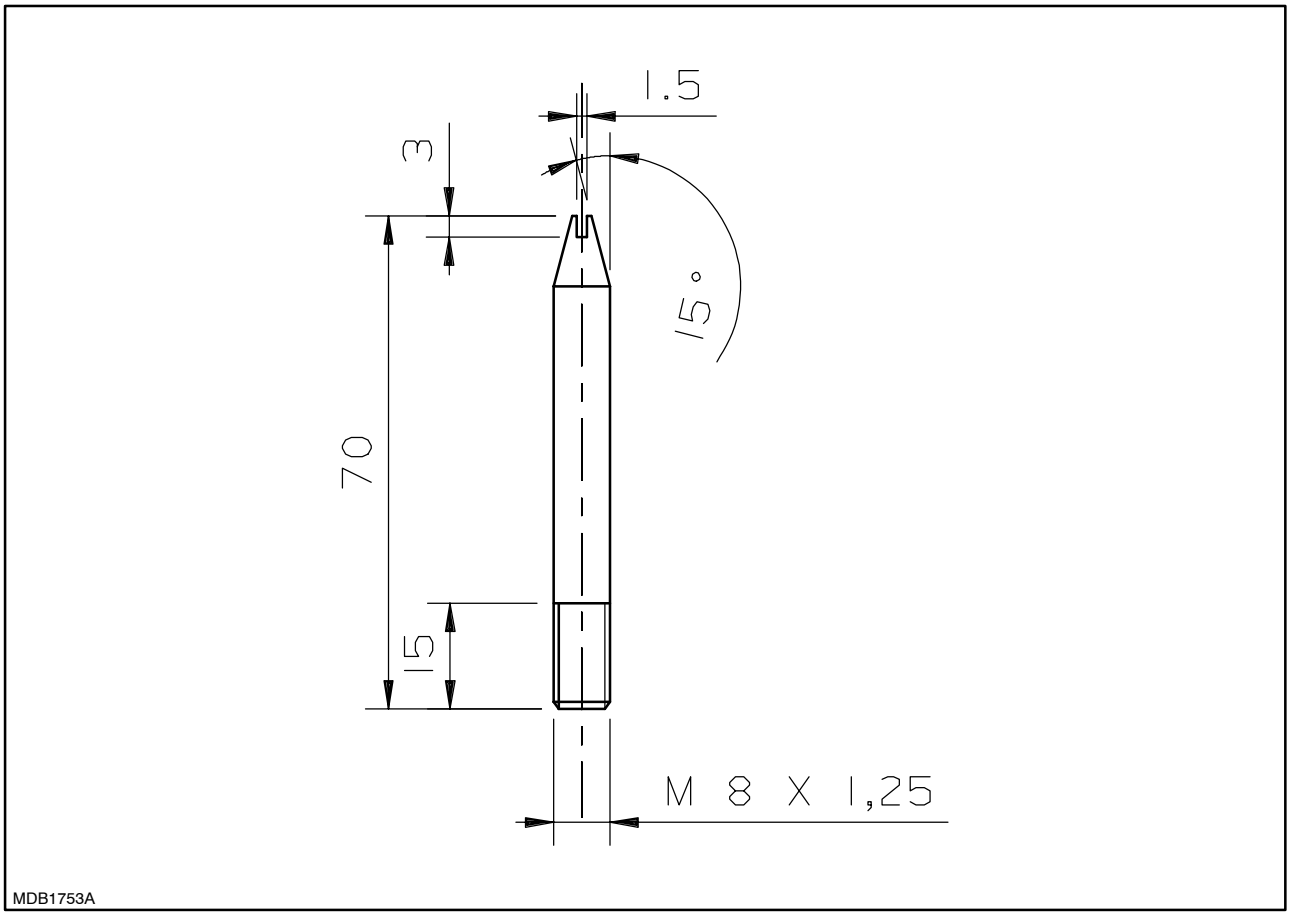
Warning - The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**.
To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

	380000227	Clutch casing lift hook.
	380000301	Rotating stand for overhaul operations.
	380000271	Front bracket (with **380000301**).
	380000272	Rear bracket (with **380000301**).
X	**380000291**	Tool for A and B clutch springs.
X	**380000290**	Tool for fitting internal hub seals on A and B clutches.
X	**380000296**	Tool for fitting clutch driving shaft seal (with **380000258**).
	380000278	Hydraulic pressure testing kit (use with union **295032**).
X	**380000243**	Press for Dual Command (2 Speed Power Shift) hydraulic clutch springs.
X	**380000244**	Dual Command (2 Speed Power Shift) hydraulic clutch shaft stop and support.
X	**380000245**	Tool for fitting seals on Dual Command (2 Speed Power Shift) hydraulic clutch hub.
X	**380000289**	Limp home device.
X	**380000282**	Control unit calibration and diagnosis instrument.
X	**380000283**	Transmission calibration device.



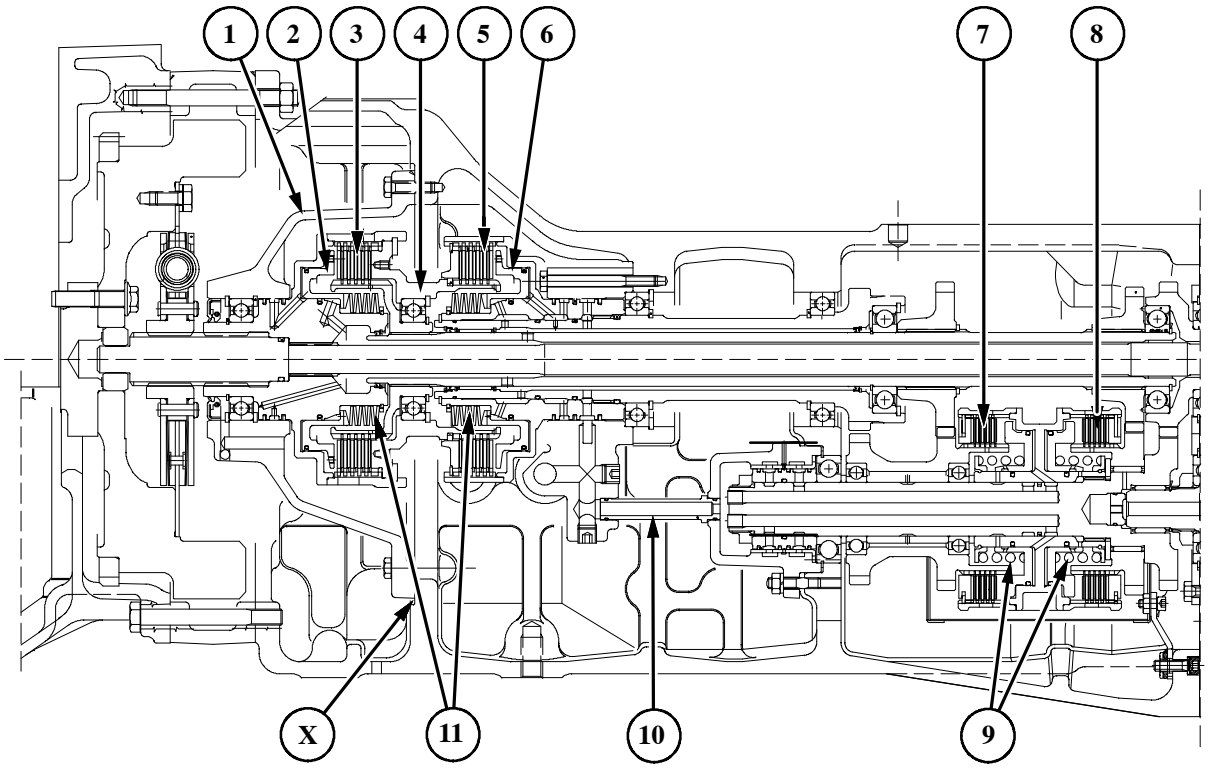
3

Tool to make for gearbox-clutch casing removal-installation on the engine
(mark tool with no. 50169 - Measurements in mm)
Construct in UNI C40 material



4

Guide pin to be made for clutch A cover removal-installation
(mark tool with no. 50223 - Measurements in mm)
Construct in UNI C40 material



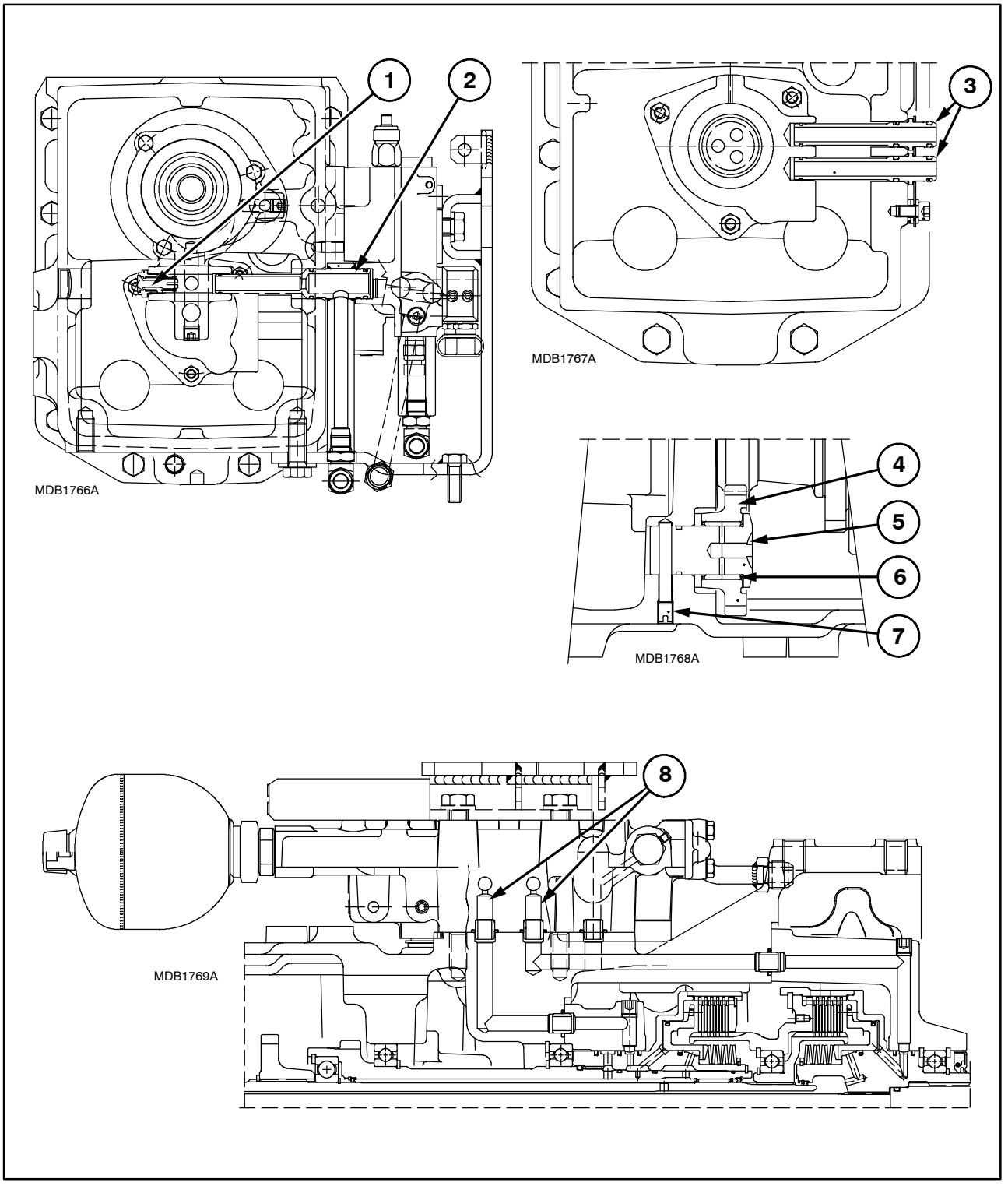
MDE0875A

5

Longitudinal cross-sectional view of Power Shuttle with Dual Command (2 Speed Power Shift) function.

1. Clutch A cover.
2. Clutch A piston.
3. Clutch A.
4. Clutches A and B hub.
5. Clutch B.
6. Clutch B piston.
7. Clutch C.
8. Clutch D.
9. Clutches C and D springs.
10. Lubrication line.
11. Clutches A and B springs.

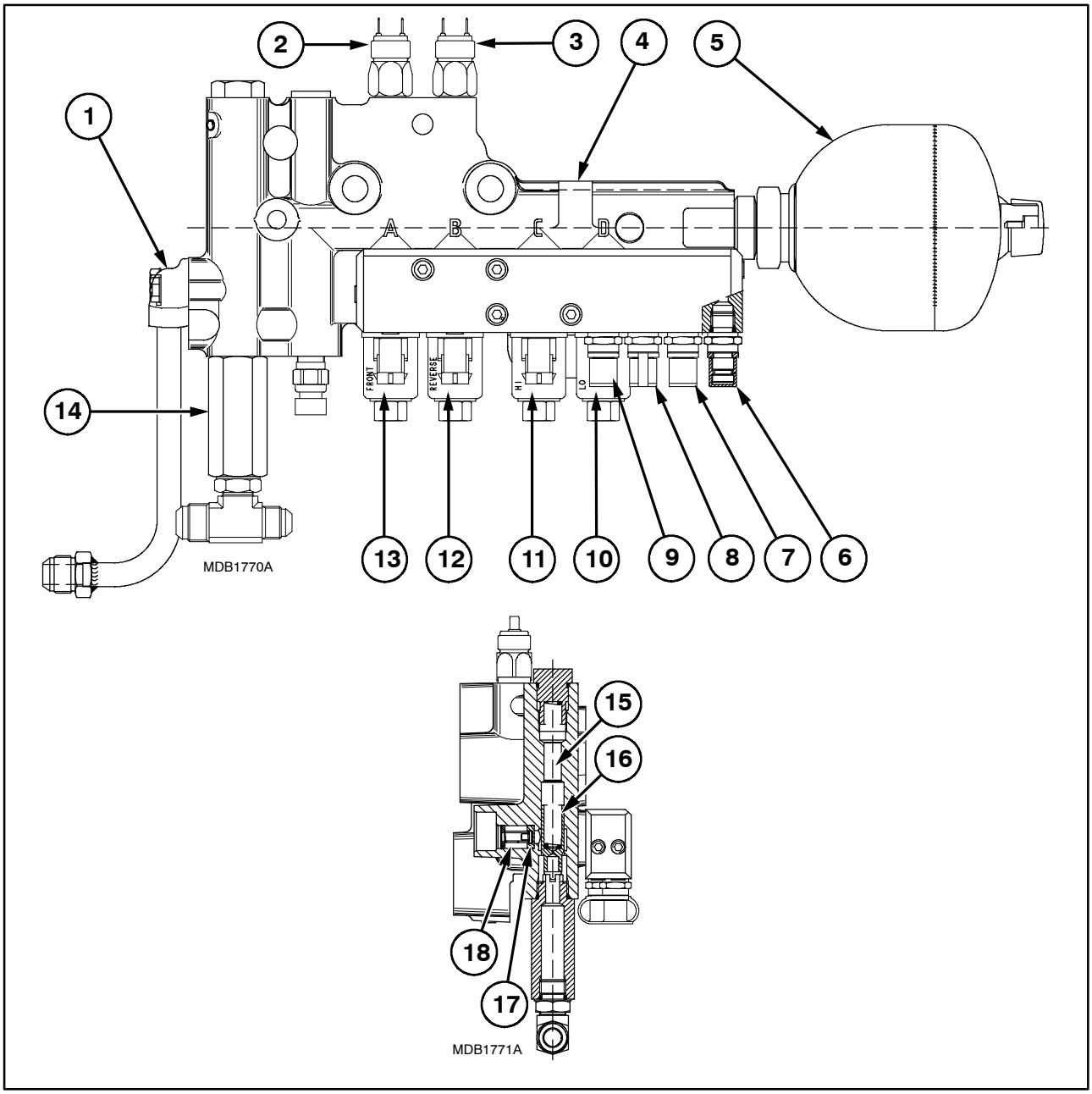
NOTE: *On assembly apply a bead of sealing compound to the surfaces* ***X*** *as indicated on page 11.*



6

Cross-sectional view of Power Shuttle with Dual Command (2 Speed Power Shift) function.

1. Lubrication oil pressure control valve.
2. Lubrication oil union.
3. Dual Command (2 Speed Power Shift) clutches (C and D) oil lines.
4. Reverse intermediate gear.
5. Gear pin (4).
6. Needle bearing.
7. Pin retaining screw (5).
8. Dual Command (2 Speed Power Shift) clutches (A and B) oil lines.



7

Cross-sectional view of Power Shuttle and Dual Command (2 Speed Power Shift) control valve.

1. Heat exchanger oil delivery union-line.
2. Clutch A line pressure gauge.
3. Clutch B line pressure gauge.
4. Control valve body.
5. Accumulator.
6. Clutch D pressure control union.
7. Clutch C pressure control union.
8. Clutch B pressure control union.
9. Clutch A pressure control union
10. Clutch D control solenoid valve.
11. Clutch C control solenoid valve.
12. Clutch B solenoid valve.
13. Clutch A solenoid valve.
14. Pump delivery oil union.
15. Pressure control valve spring (16).
16. Oil pressure control valve.
17. By-pass valve.
18. By-pass valve spring.

DESCRIPTION AND OPERATION

Gearbox

4-speed gearbox with constant-mesh helical gears controlled by two synchronizers.

The range gear has cascade-type constant-mesh spur gears.

The range gear provides 3 gear ranges.

The gearbox and the range gears are controlled by two independent levers located on the right-hand side of the operator.

Lubrication is by means of the oil in the rear transmission/gearbox casing.

Power Shuttle unit (see fig. 5)

The Power Shuttle unit is composed of two multi-disk clutches in an oil bath located in the front part of the clutch casing, and is controlled by a control valve attached to the left-hand side of the clutch casing.

This provides hydraulic control of 4 gears for each range, both forward and in reverse.

Gear and range selection is carried out by means of the clutch pedal and operating the control levers, located on the right-hand side of the operator.

The front clutch (A) commands the forward gears and the rear clutch (B) commands the reverse gears.

Forward or reverse gear is selected by means of the lever under the steering wheel to the left of the operator; there is no need to use the clutch pedal.

The Power Shuttle unit provides 12 forward gears and 12 reverse gears.

Dual Command (2 Speed Power Shift) unit (see fig. 5)

The Dual Command (2 Speed Power Shift) is composed of two multi-disk clutches in an oil bath located on the driven shaft in the rear part of the clutch casing, and is controlled by the same control valve as the Power Shuttle.

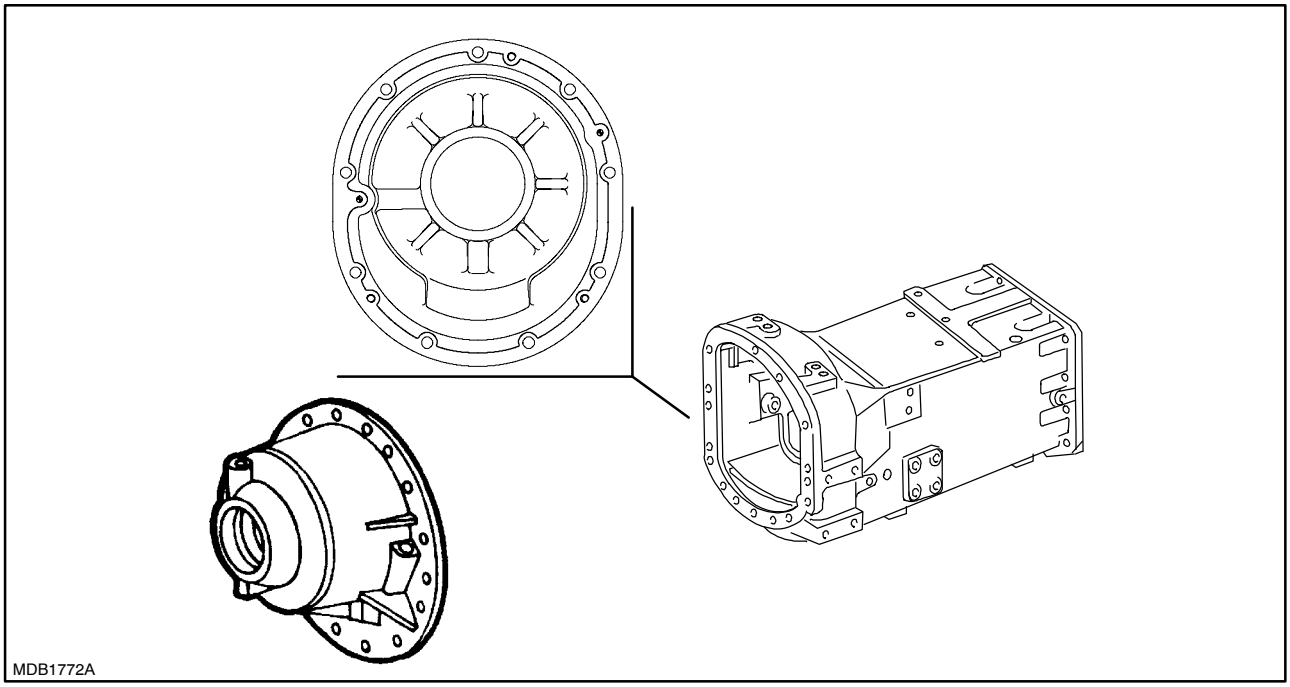
The Dual Command (2 Speed Power Shift) provides two speeds within the same gear.

The two speeds (HIGH or LOW) are selected by means of two push-buttons located on the gearshift lever.

The HIGH speeds are commanded by the front clutch (C), whereas the LOW speeds are commanded by the rear clutch (D).

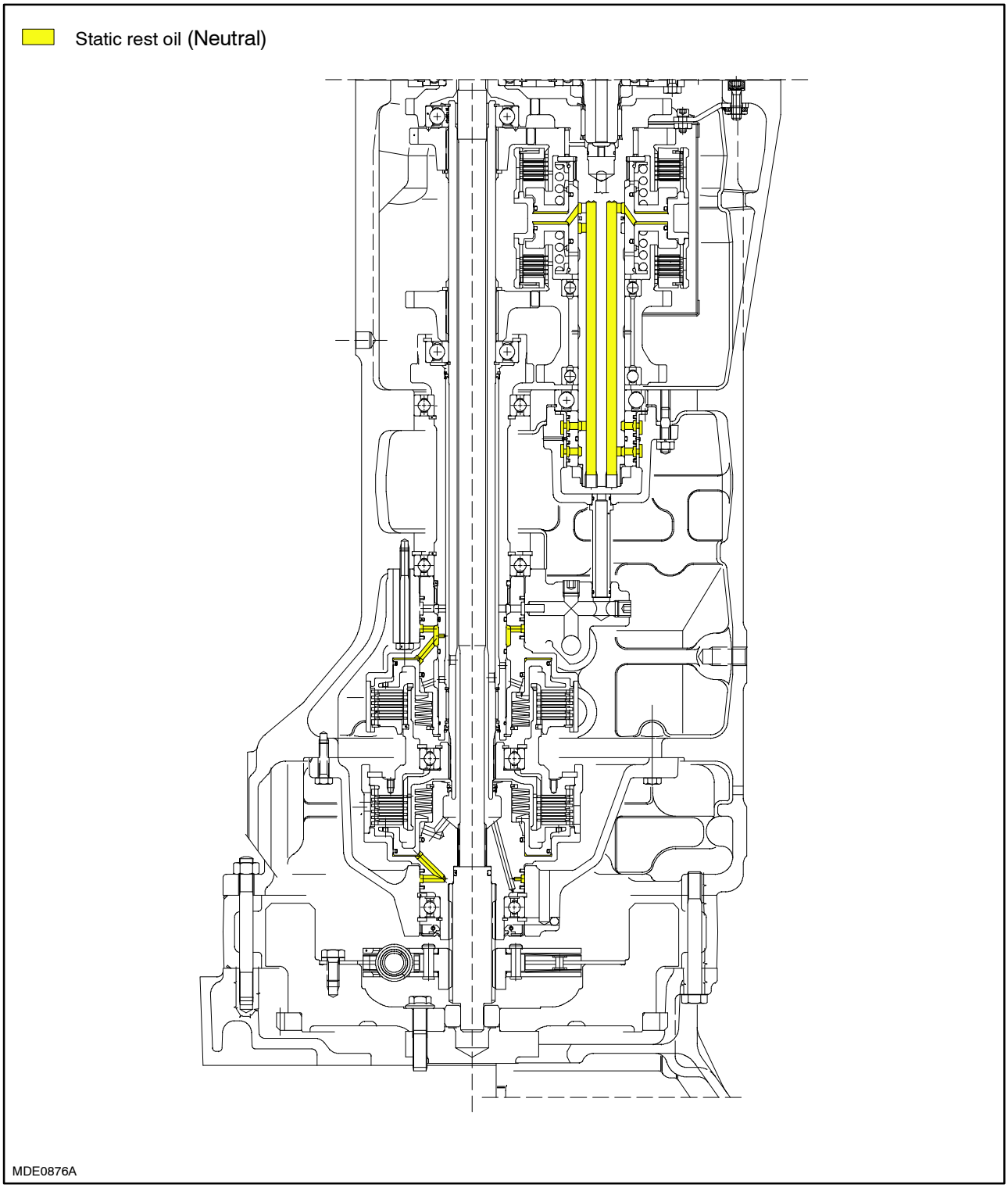
The Dual Command (2 Speed Power Shift) provides 24 forward gears and 24 reverse gears.

For a more thorough understanding of its operation, here we give the hydraulic diagrams and the relevant sequences.



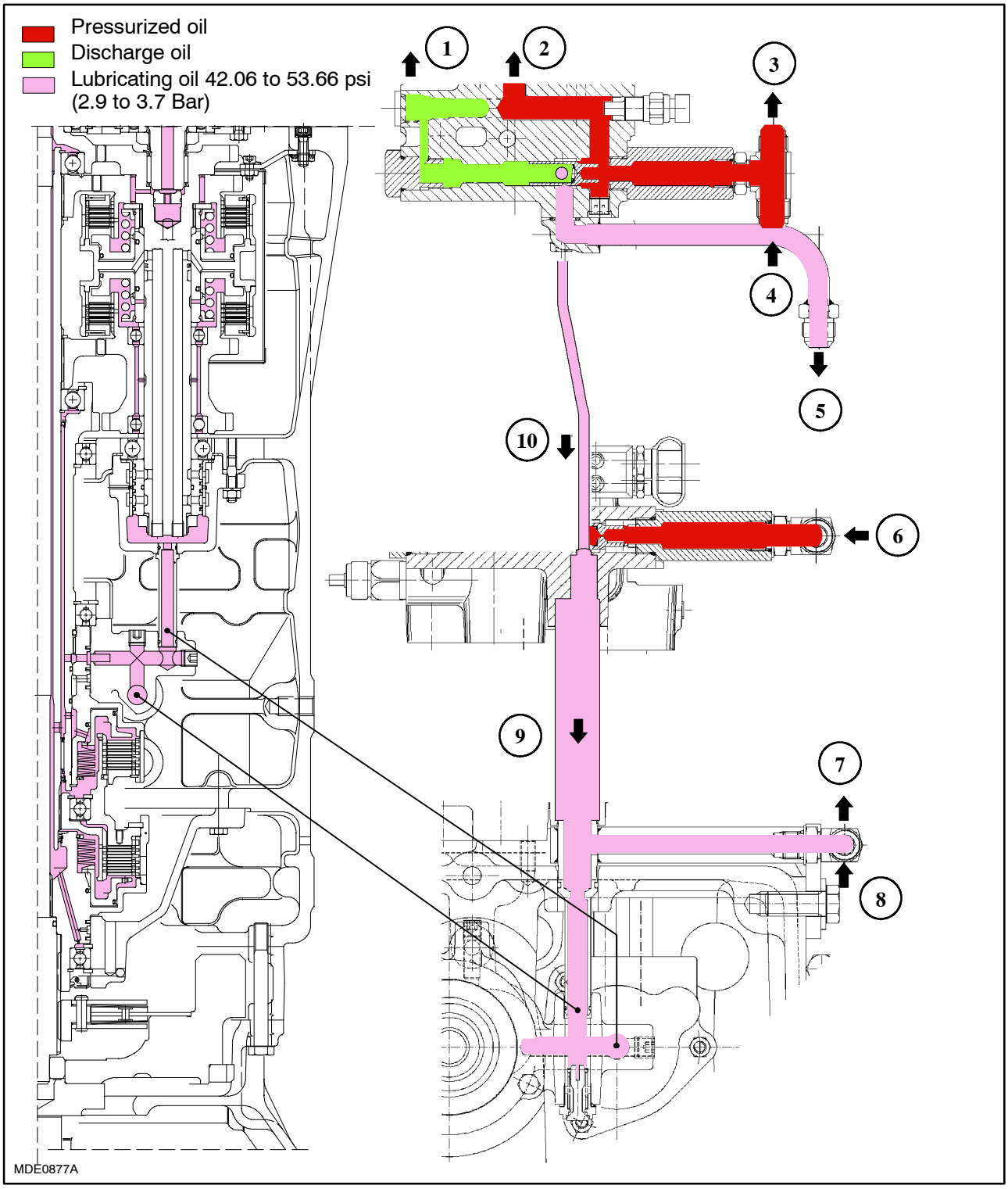
8

Sealing compound application diagram for clutch A cover.
The types of sealing compounds to be applied are specified in **Section 1.**



9

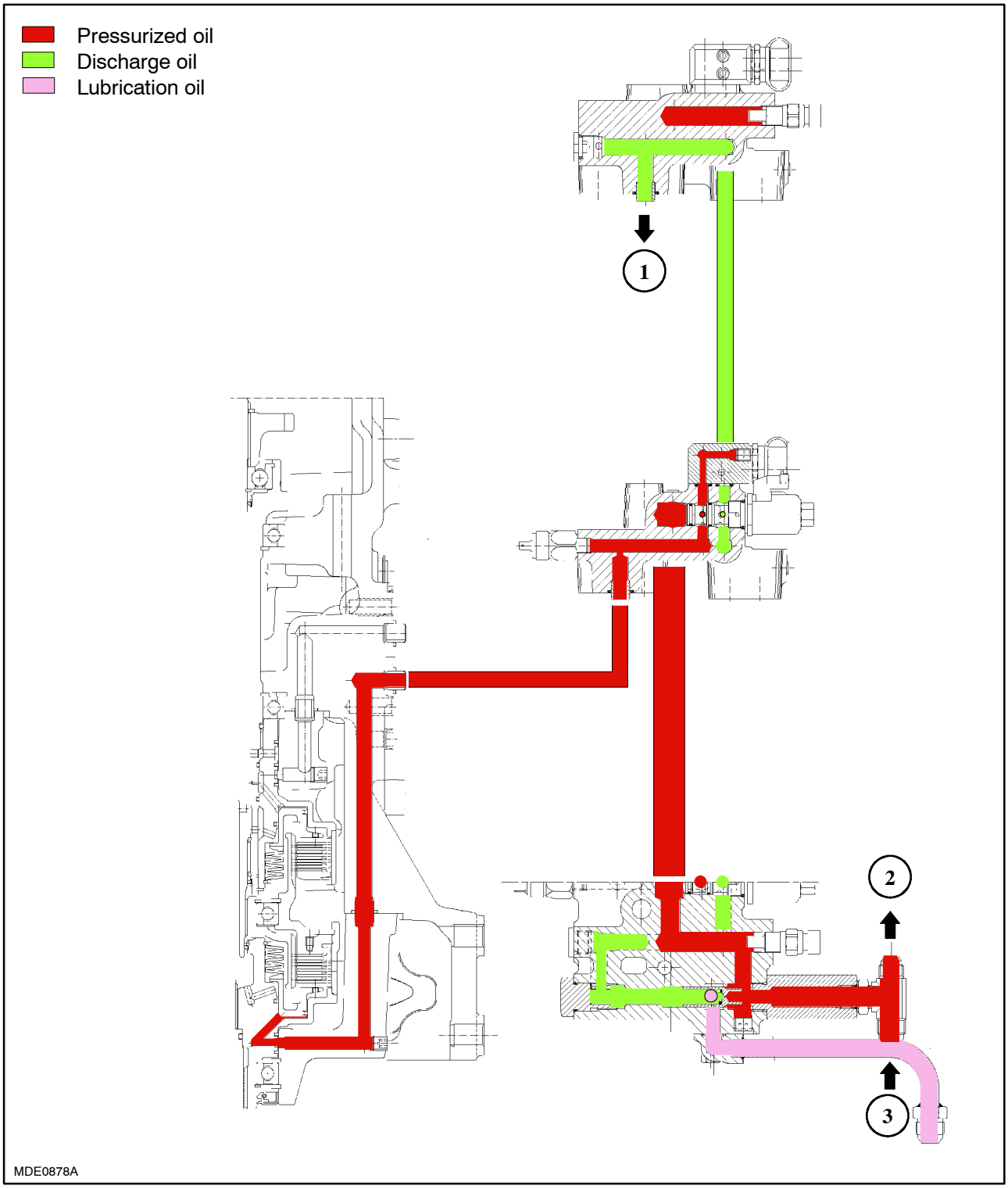
Power Shuttle transmission with Dual Command (2 Speed Power Shift) function (24+24), 18.64 mph (30 km/h) version (Neutral)



10

Power Shuttle transmission with Dual Command (2 Speed Power Shift) function (24+24) - Lubrication circuit

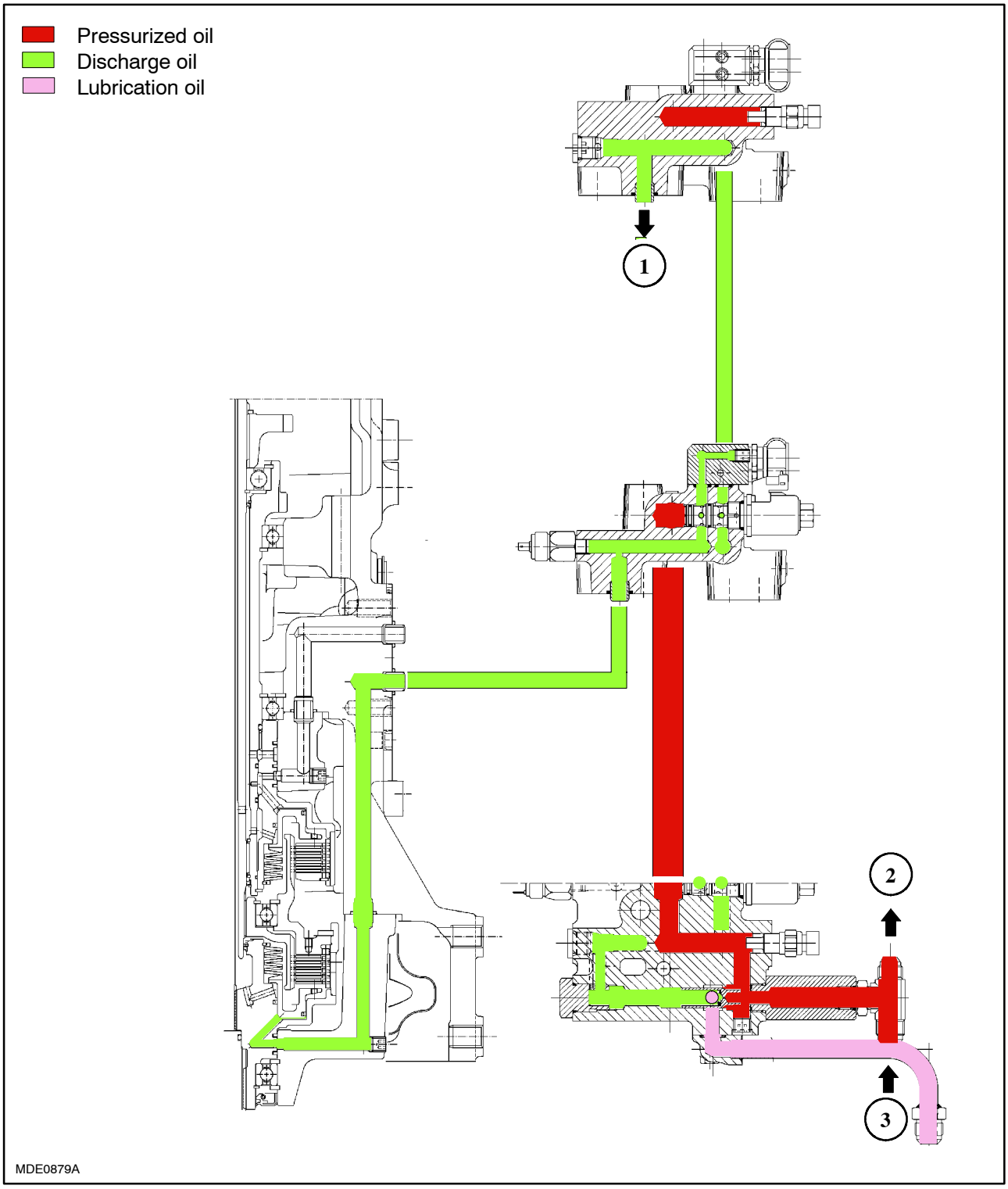
1. Discharge oil
2. Oil to solenoid valves
3. Oil to the differential lock, four-wheel drive, power take-off and p.t.o. brake
4. Pressurized oil from the pump
5. Hot oil to the heat exchanger
6. Pressurized oil from the pump
7. Power take-off lubrication
8. Cold oil from the heat exchanger
9. Cold oil to lubrication
10. Cold oil to the by-pass valve



11

Power Shuttle transmission with Dual Command (2 Speed Power Shift) function (24+24) - Clutch A under pressure

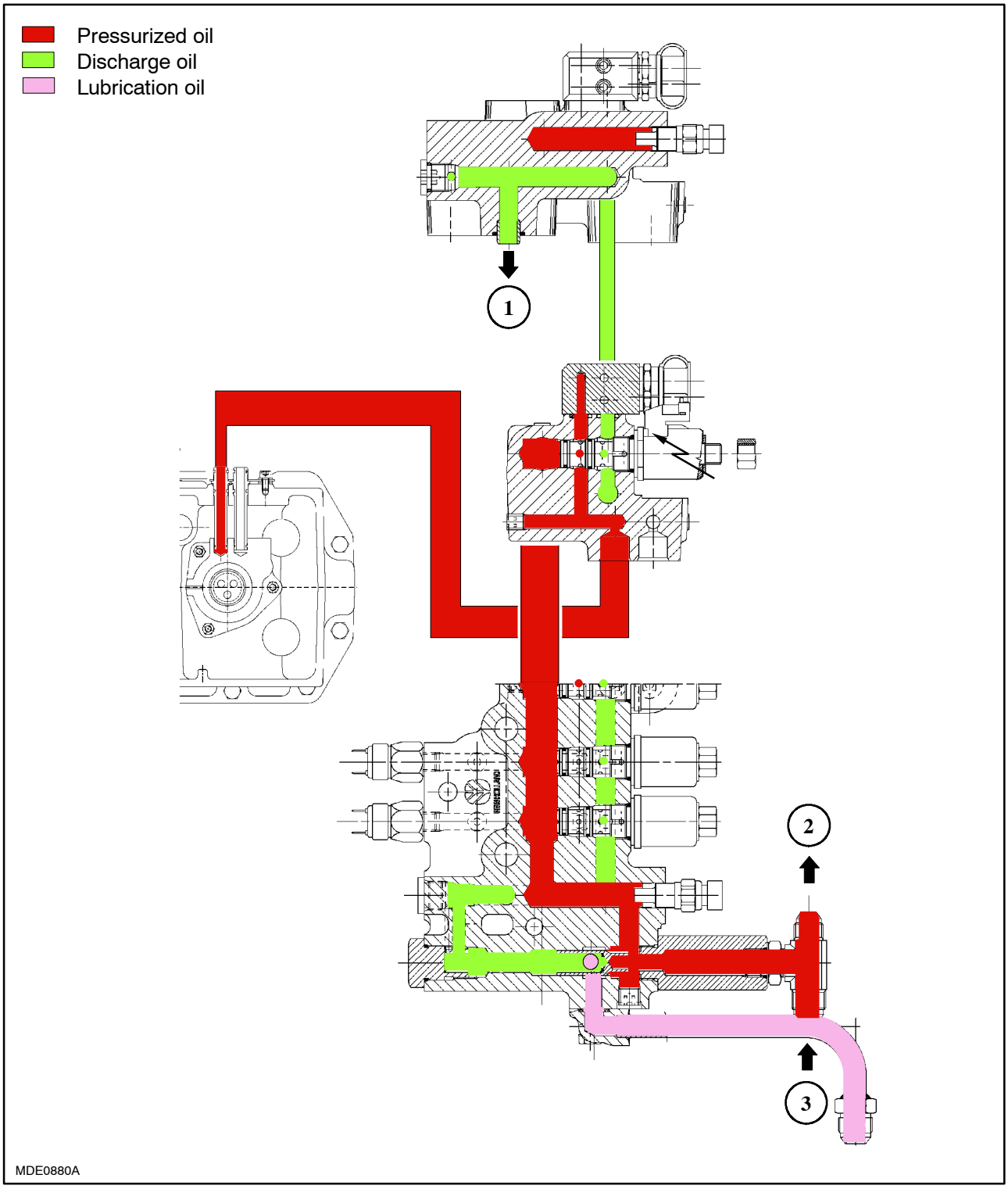
1. Discharge oil
2. Oil to the differential lock, four-wheel drive, power take-off and p.t.o. brake
3. Oil from the pump



12

Power Shuttle transmission with Dual Command (2 Speed Power Shift) function (24+24) - Clutch A in discharge

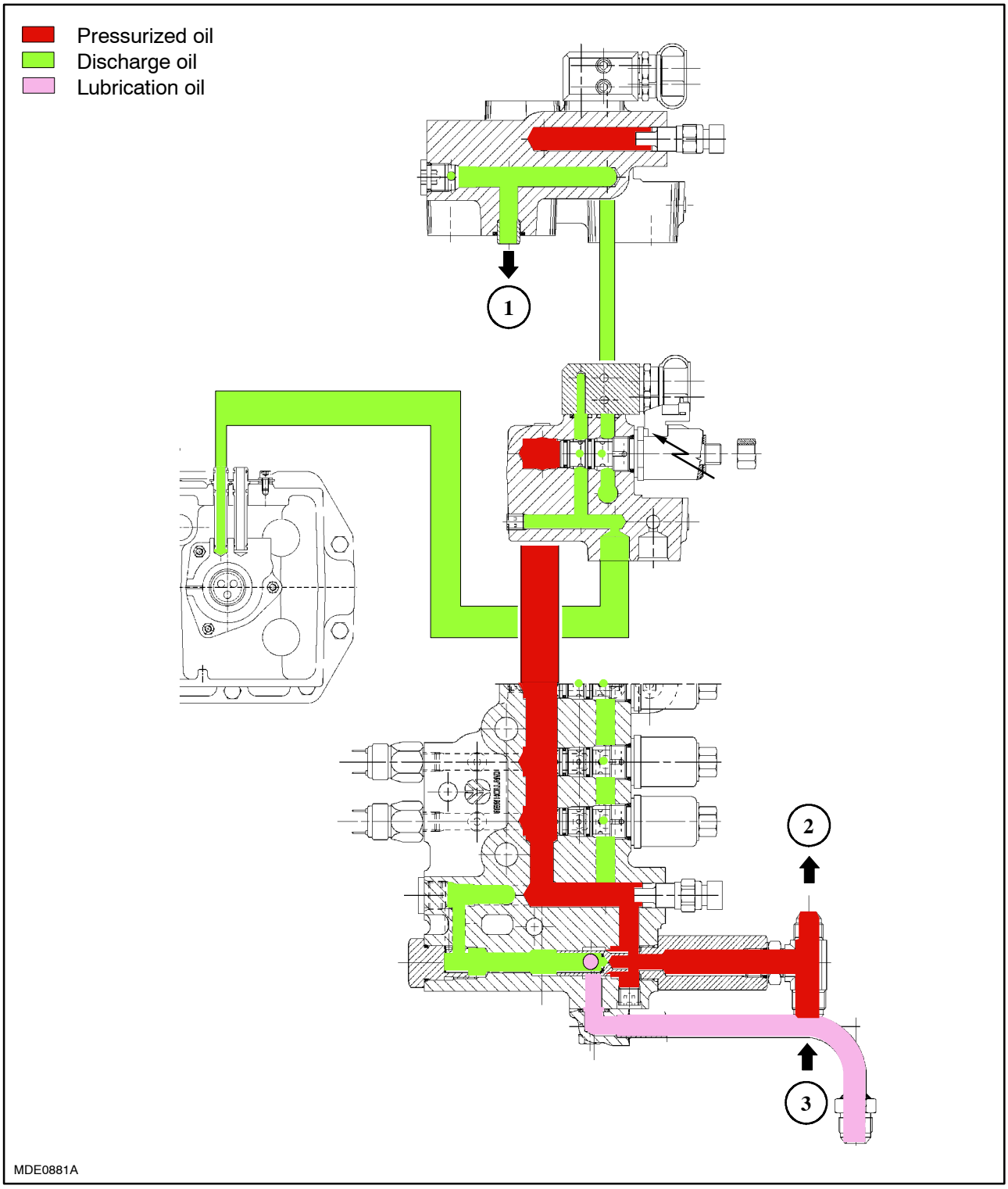
1. Discharge oil
2. Oil to the differential lock, four-wheel drive, power take-off and p.t.o. brake
3. Oil from the pump



13

Power Shuttle transmission with Dual Command (2 Speed Power Shift) function (24+24) - Clutch C under pressure

1. Discharge oil
2. Oil to the differential lock, four-wheel drive, power take-off and p.t.o. brake
3. Oil from the pump



14

Power Shuttle transmission with Dual Command (2 Speed Power Shift) function (24+24) - Clutch C in discharge

1. Discharge oil
2. Oil to the differential lock, four-wheel drive, power take-off and p.t.o. brake
3. Oil from the pump

Op. 21 110 88

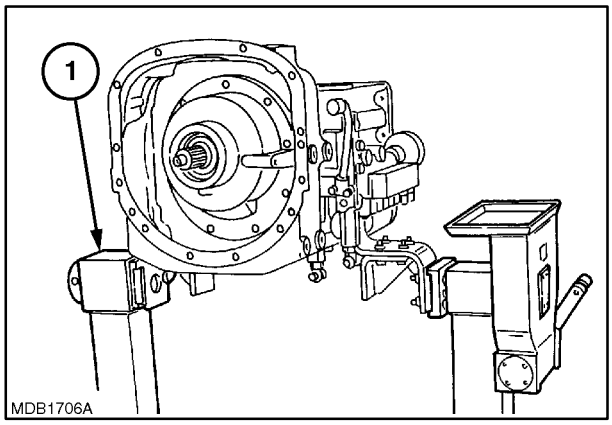
CLUTCH CASING WITH POWER SHUTTLE AND DUAL COMMAND (2 SPEED POWER SHIFT) UNITS D.A.

CAUTION

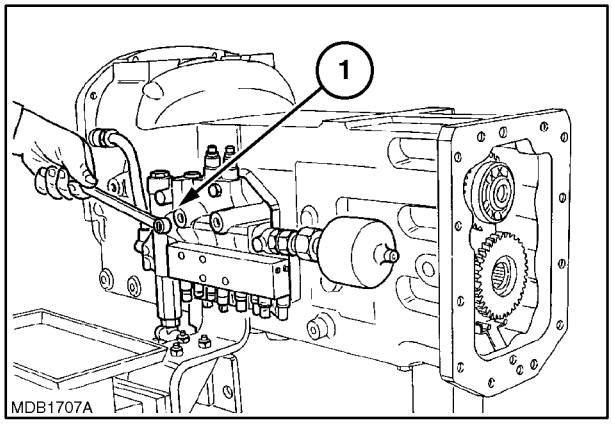
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Proceed as follows.

1. Fix the gearbox -transmission casing to the rotating stand **380000301** (1) using front **380000271** and rear **380000272** brackets.
2. Unscrew the retaining screws and remove the control valve (1).

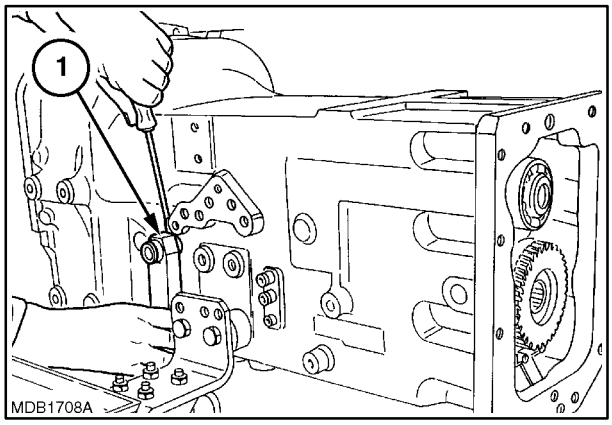


15



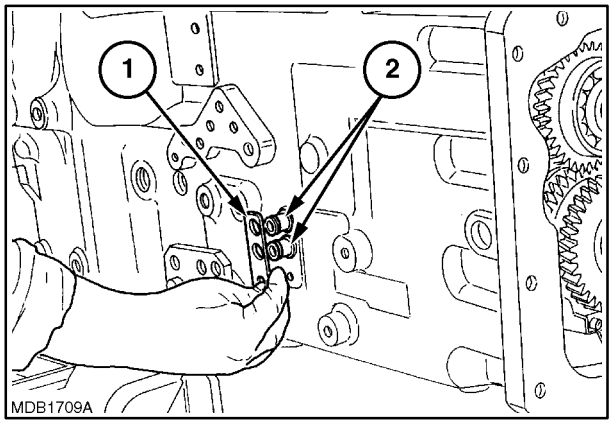
16

3. Extract the oil drainage union (1).



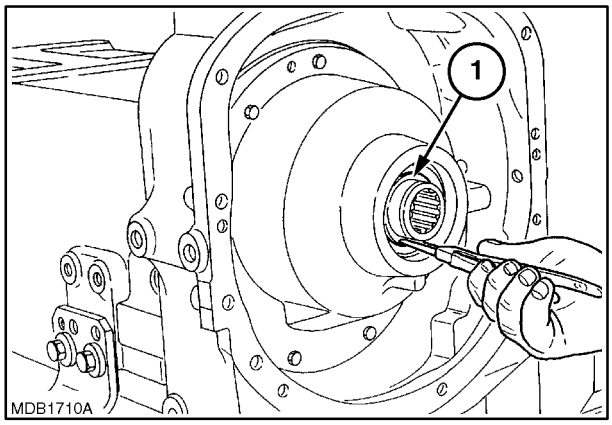
17

4. Unscrew the retaining screw, detach the bracket (1) and remove the control valve/internal manifold connecting lines (2).



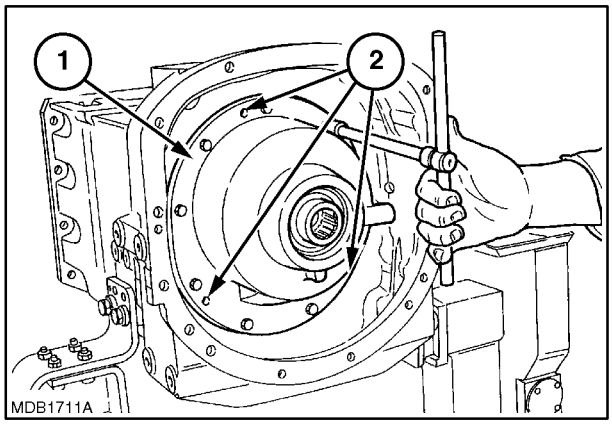
18

5. Remove the seal and the snap ring (1).



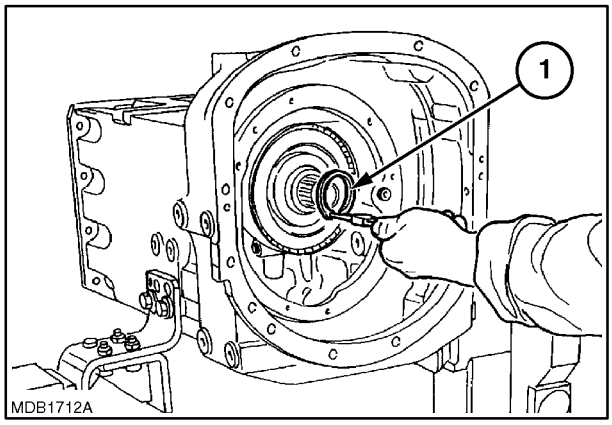
19

6. Unscrew the cover retaining screws (1) on the clutch (A, fig. 5) tighten three screws in the extraction holes (2) and remove the cover (1).



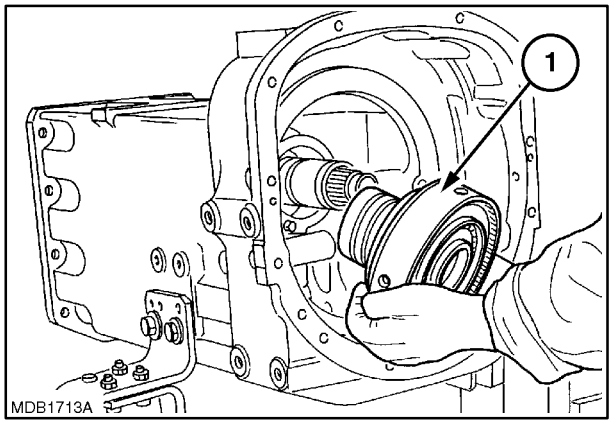
20

7. Remove the snap ring (1) that secures the clutch (B, fig. 5).



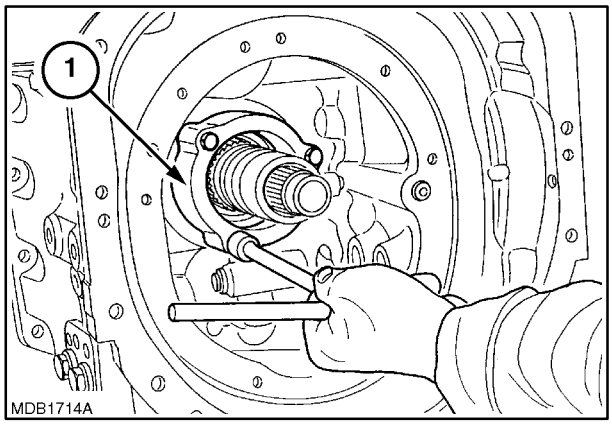
21

8. Extract clutch B (1) from the shaft and remove.



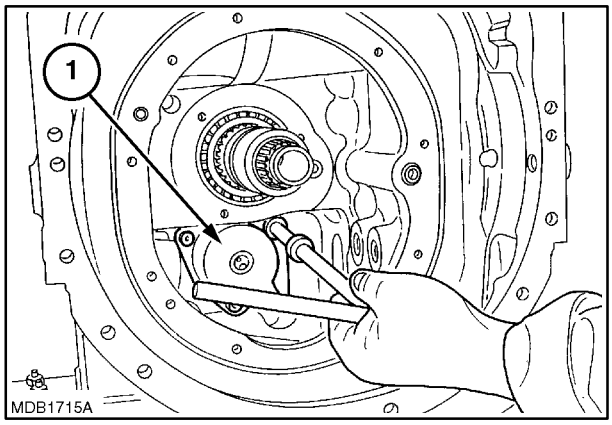
22

9. Unscrew the retaining screws and the lubrication manifold (1) together with the Dual Command (2 Speed Power Shift) clutch unit lubrication lines.



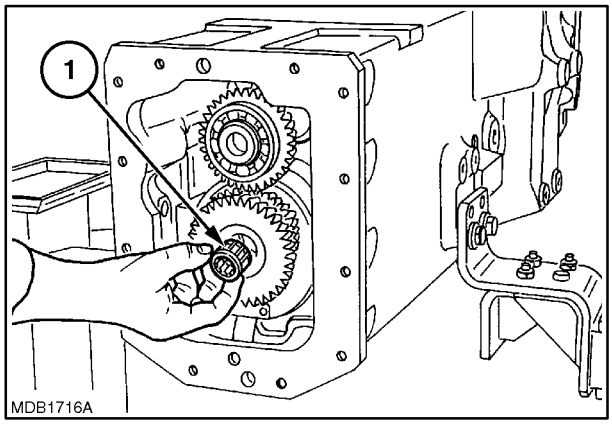
23

10. Unscrew the retaining screws and remove the Dual Command (2 Speed Power Shift) clutch shaft manifold cover (1).



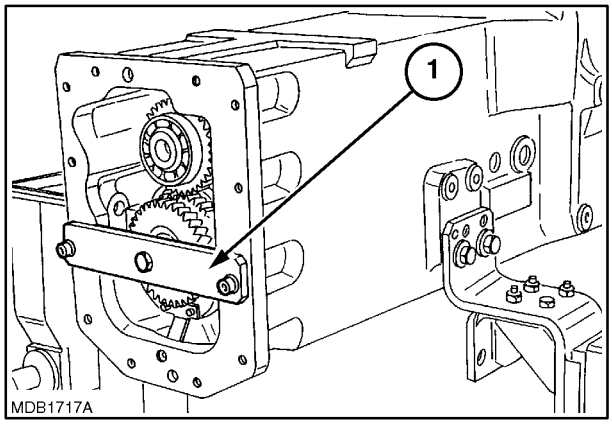
24

11. Remove the Dual Command (2 Speed Power Shift) clutch shaft bearing (1).



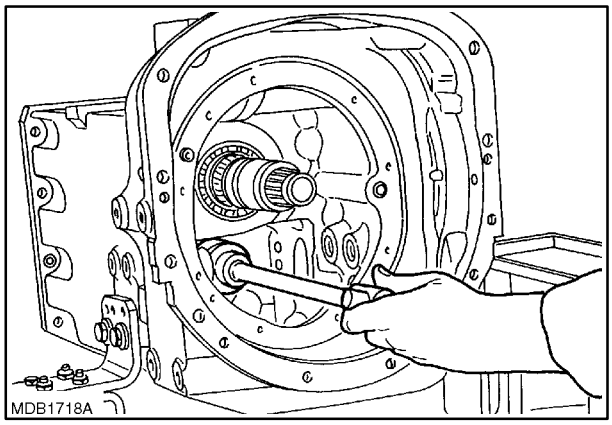
25

12. Position and secure tool **380000244** (1) on the clutch casing.



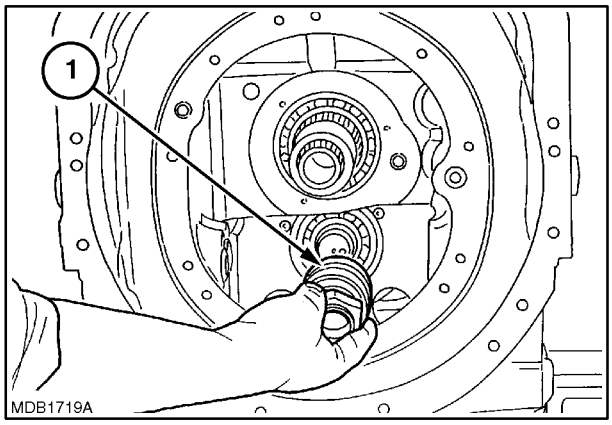
26

13. Remove the nut on the Dual Command (2 Speed Power Shift) clutch shaft.



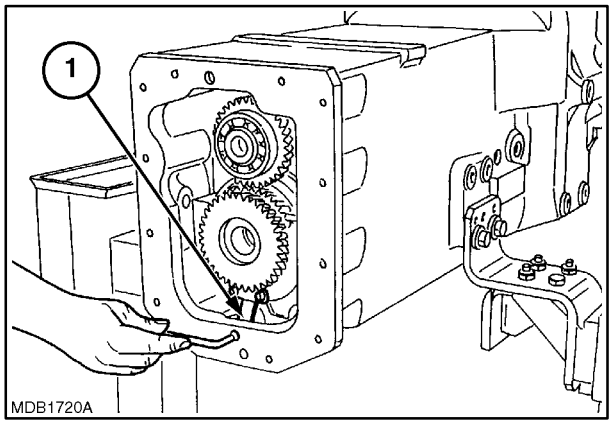
27

14. Extract the manifold ring (1) from the Dual Command (2 Speed Power Shift) clutch shaft.
15. Disassemble tool **380000244** (1, fig. 26).



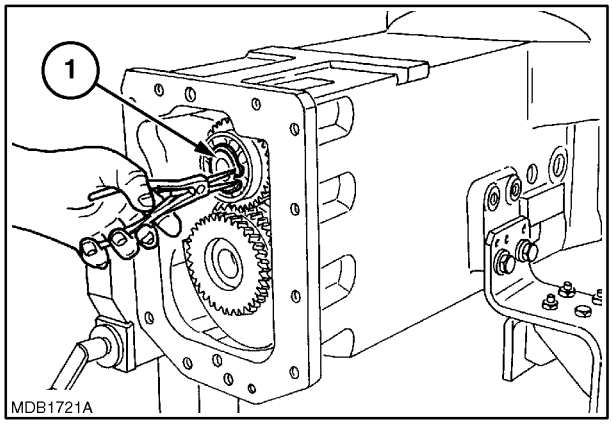
28

16. Take out the retaining bolts and remove the bracket (1).



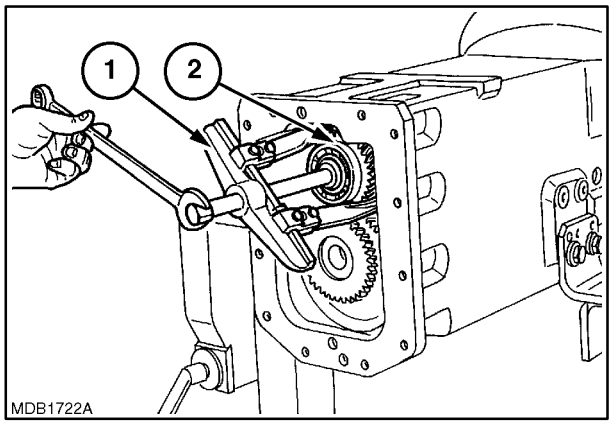
29

17. Remove the snap ring (1) on the driving shaft.



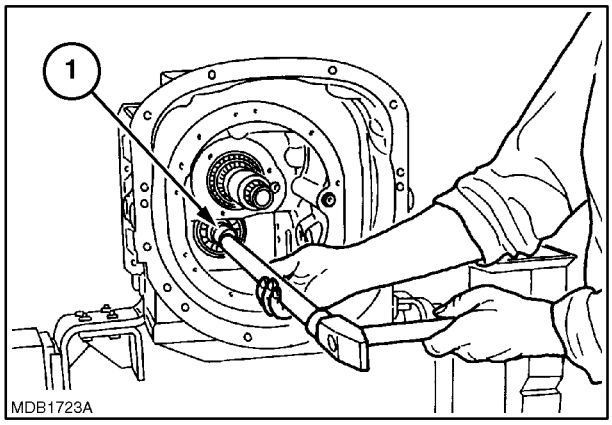
30

18. Using a puller (1) extract the gear (2) with its bearing.



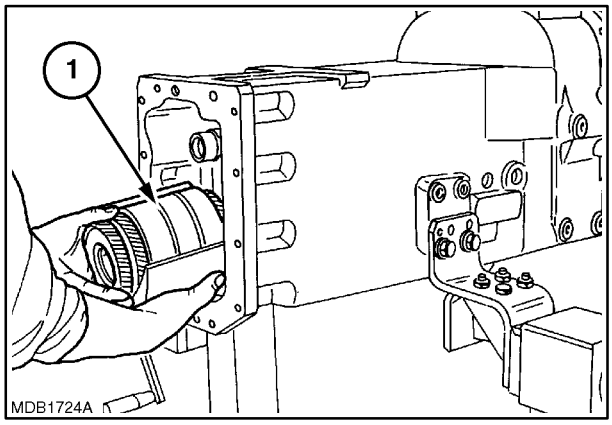
31

19. Using a suitable punch, tap the Dual Command (2 Speed Power Shift) clutch shaft (1) and extract it from the bearing.



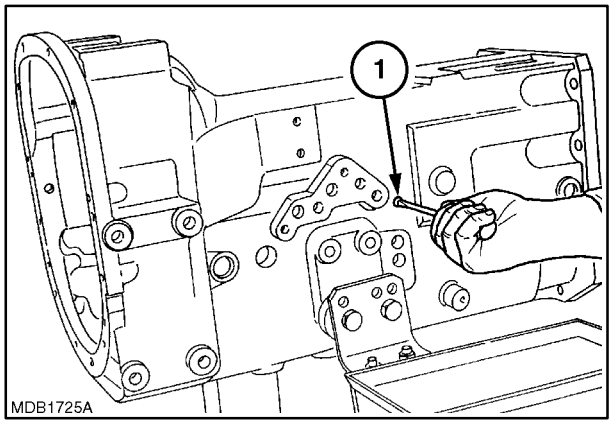
32

20. Remove the shaft together with the Dual Command (2 Speed Power Shift) clutches (1).



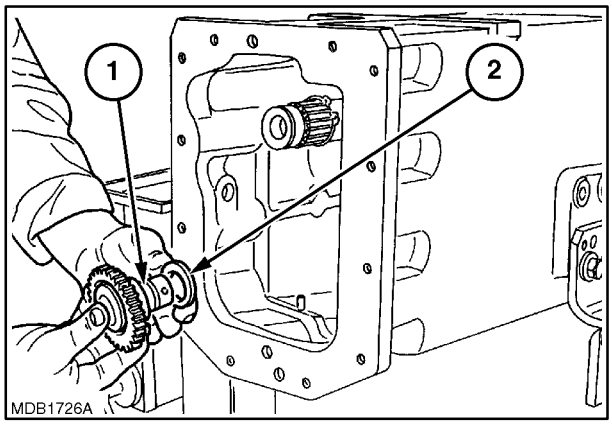
33

21. Remove the grub screw (1) on the reverse gear unit pin.



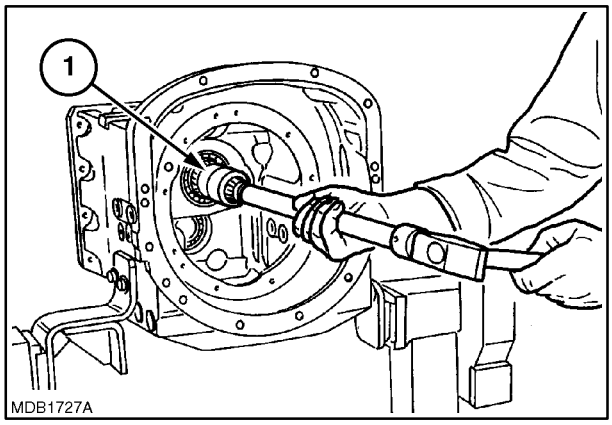
34

22. Working from the front side of the clutch casing, tap the reverse gear unit pin (1) with a punch and remove the unit from the rear side, together with the thrust washer (2).



35

23. Using a suitable punch, tap the driving shaft (1).



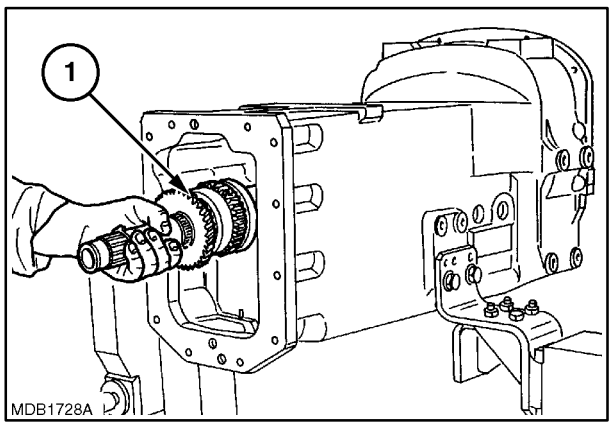
36

24. Remove the driving shaft (1), working from the rear side of the clutch casing.

Driving shaft - Removal-Installation (see Section 21 chap. 4, page 32)

Driving shaft - Removal-Installation (see Section 21 chap. 4, page 33)

25. To refit the clutch casing, proceed as follows.



37

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- For the correct orientation of the various parts, refer to the illustrations in figs. 5, 6 and 7.
- Before refitting the casings, supports and covers clean and de-grease the mating surfaces and apply sealing compound (approx. 2 mm in diameter) as shown in figure 8.
- Respect the tightening torques listed on pages 4 and 5.

- Assemble the rear gear unit, bearing and snap ring on the drive shaft; secure the assembly using tool **380000244** (1).

- Fit the thrust washer, gear unit and reverse pin, securing in position with the screw.

- Assemble the Dual Command (2 Speed Power Shift) shaft and lock in position with tool **380000244**.

- Assemble and secure the bracket with guard on the Dual Command (2 Speed Power Shift) clutch shaft.

- Fit the manifold ring on the Dual Command (2 Speed Power Shift) clutch shaft, tighten and secure the nut.

- Remove tool **380000244** and fit the bearing in the seat on the Dual Command (2 Speed Power Shift) clutch shaft.

- Assemble and secure the manifold cover on the Dual Command (2 Speed Power Shift) clutch shaft.

- Assemble and secure the lubrication manifold, complete with Dual Command (2 Speed Power Shift) clutch unit lubrication line.

- Position clutch (B, fig. 5) on the shaft and secure with the snap ring.

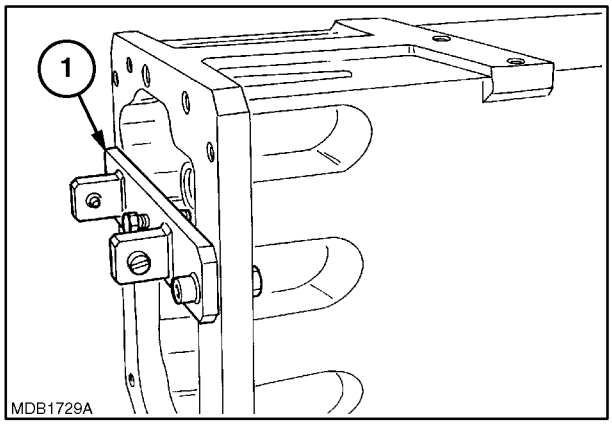
- Assemble and secure the cover and clutch (A, fig. 5).

- Fit the seal and the snap ring on the clutch A cover.

- Insert the control valve-internal manifold connecting lines, position and secure the relative bracket.

- Insert the oil drainage union.

- Position and secure the control valve.



38

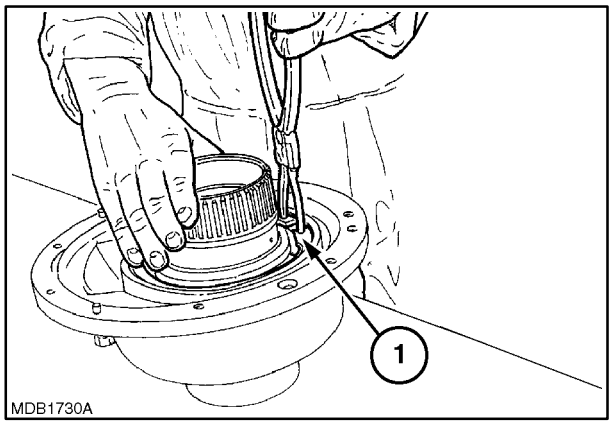
Op. 21 154 60
CLUTCH A D.A.

CAUTION

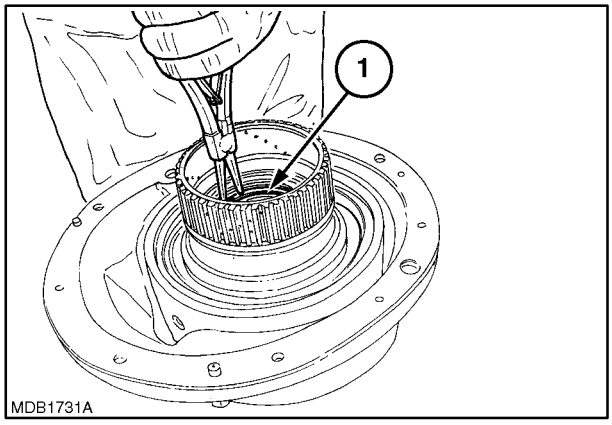
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Proceed as follows.

1. Remove the circlip (1).
2. Remove the circlip (1).

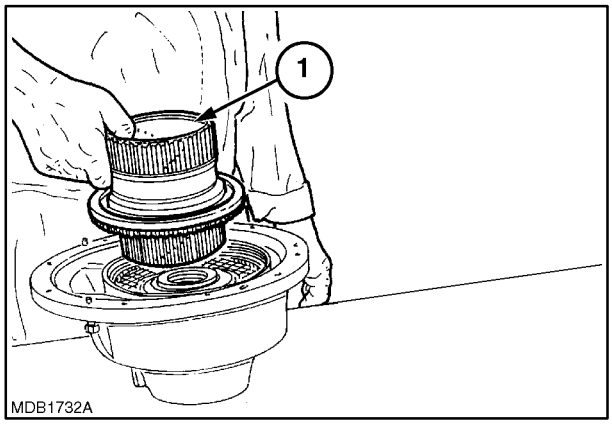


39



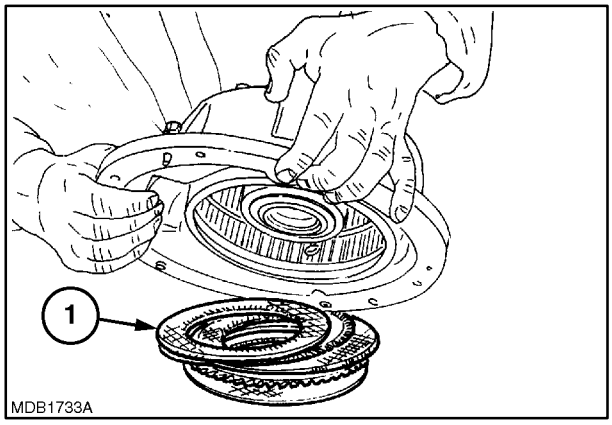
40

3. Remove the clutch hub (1).



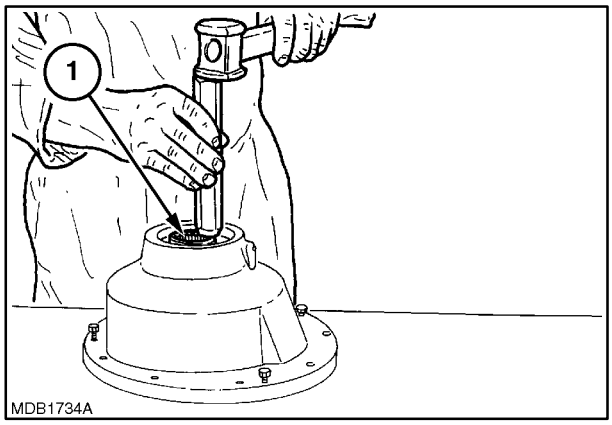
41

4. Remove the clutch disk assembly (1) (A, fig. 5).



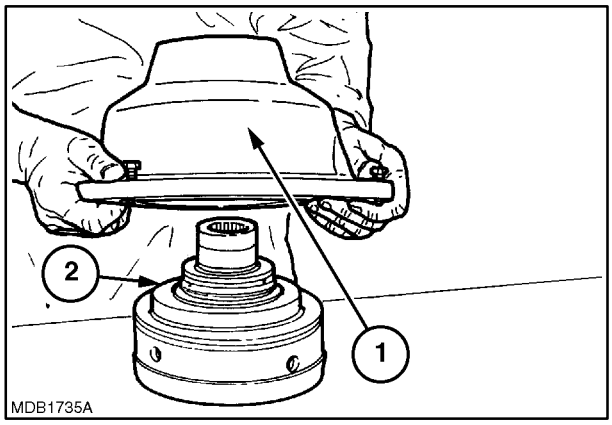
42

5. Using a brass punch, tap on the hub (1) on clutch casing A.



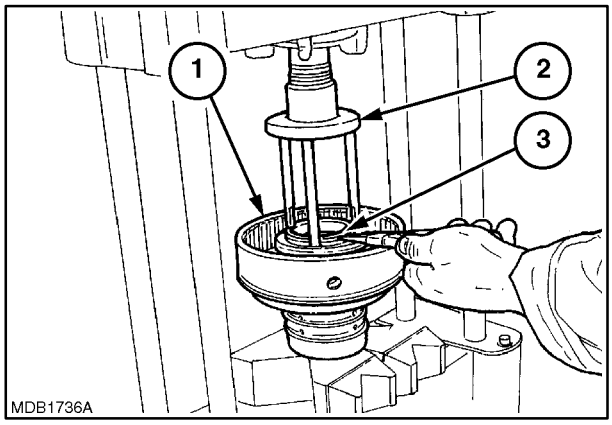
43

6. Extract the cover (1) and remove the clutch casing A (2).



44

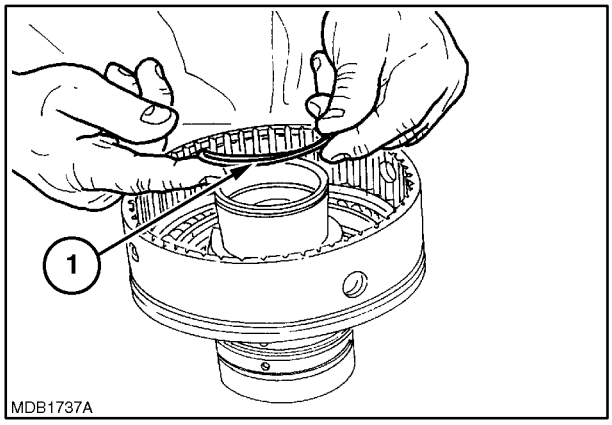
7. Position the clutch casing A (1) under a press and, using tool **380000291** (2) and adapter, compress the springs, remove the stop ring (3) and remove the Belleville washer.



45

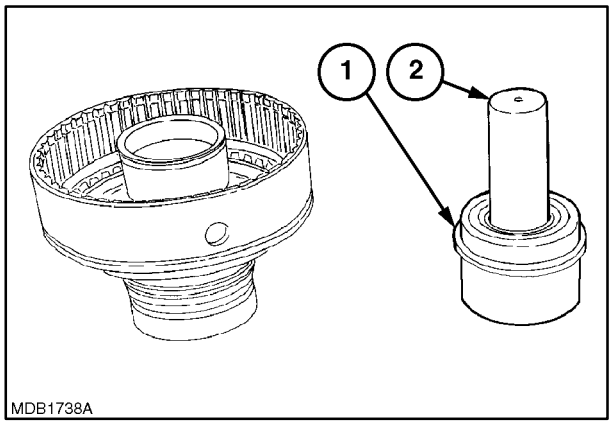
Replacing the seal on the clutch casing internal hub.

8. Position the O-Ring seal (1) in the relative seat on the clutch casing internal hub.



46

9. Position the external ring (1) of the seal on the guide on tool **380000290** (2).

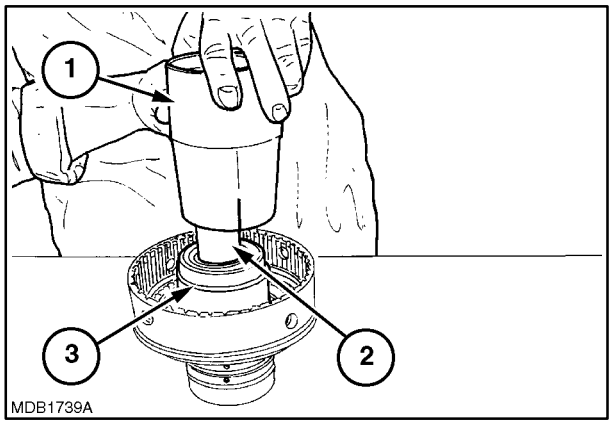


47

10. Position the guide (2) on tool **380000290** on the clutch casing internal hub and push the ring (3) into position using the press (1) on tool **380000290**.
11. **To refit the clutch (A**) proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



48

- Position the clutch casing (A) under a press and, using tool **380000291**, fit the Belleville washer stop ring.
- Fit the clutch casing (A) on the relative cover.
- Assemble the clutch disk assembly.
- Position the clutch hub in its seat and secure with the snap rings.

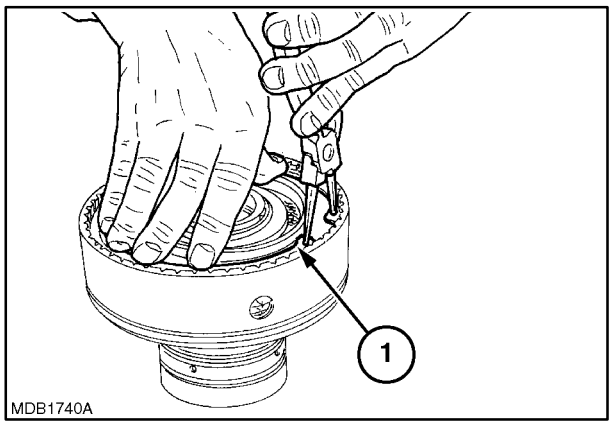
Op. 21 154 60
CLUTCH B D.A.

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Proceed as follows.

1. Take off the circlip (1) and remove the disk assembly.
2. Carry out operations no. 7, 8, 9, 10 and 11 as described above.



49

FAULT CODE INDICATION

In the event of an electrical or electronic fault, any irregular conditions are indicated by the illumination of an indicator lamp (1).

FAULT CODE DECODING

The indicator (1) identifies the error code in six phases:

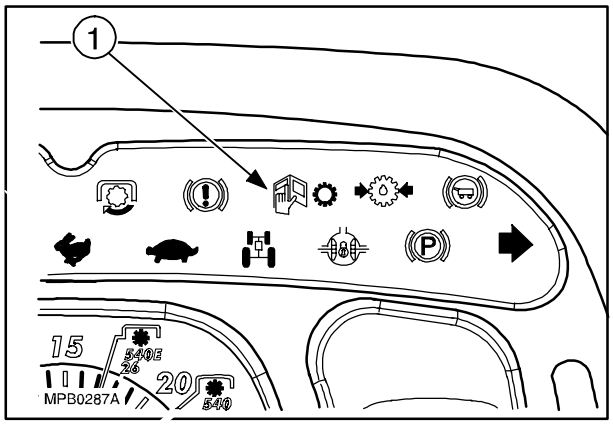
1. 5 flashes in rapid succession to indicate imminent transmission of the error code;
2. 2 second pause;
3. n... flashes to indicate the first figure of the fault code;
4. 1 second pause;
5. n... flashes to indicate the second figure of the fault code;
6. 3 second pause.

The control unit only indicates one code at a time, giving priority to the most serious faults.

If a higher priority fault occurs whilst a lower priority fault is being displayed, the display sequence of higher priorities will wait until the sequence in progress ends, before becoming active.

To check for the presence of other codes the fault must be eliminated, allowing the control unit to proceed to the following fault.

IMPORTANT: *If a fault disables the lift control function, the corresponding code will take precedence over other codes that were previously indicated; these codes will be saved by the system.*



50

- Example of the interpretation of fault code number 21 -

1st phase	2nd phase	3rd phase	4th phase	5th phase	6th phase
●●●●●	pause	●●	pause	●	pause
code transmission warning	2s	first digit 2	1s	second digit 1	3s
		fault code composition 21			

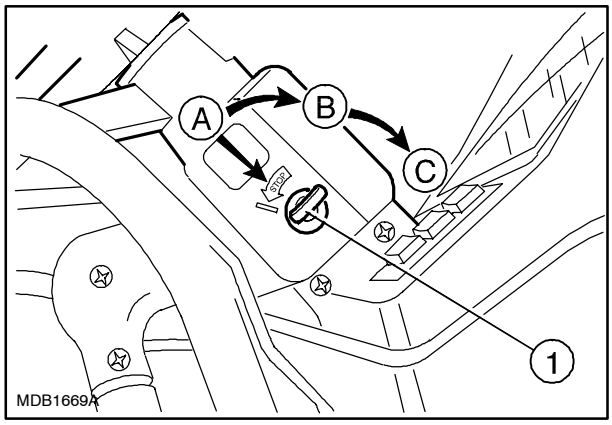
CALIBRATIONS

Calibration unit use

Specific remote diagnosis operations can be carried out with the Calibration and Diagnosis Unit (CDU).

Error codes

If the Faults Detection Logic reads a fault condition, the code will flash on the indicator. In this manner, the fault condition can be displayed whilst in HH mode. During calibration, certain faults may be masked.



51

HH MENU ACCESS

1. Turn the switch (1) to A (OFF) and connect the CDU device **294084** to the diagnosis connector (black connector).
2. By holding down the H MENU key (1) on the CDU, turn switch (1, fig. 51) to B and, where requested, to C to start the engine.
3. After a brief pause, the display (2) shows:

   HH MENU
4. Release the H MENU key (1) on the CDU.
5. Select the required H menu by pressing the H MENU key (1) the correct number of times to display the relative code on the display (2), e.g.: once to access H1, five times to access H5, etc. Each time key (1) is pressed, the display (2) shows the H code obtained, i.e.: H1, H2 etc.

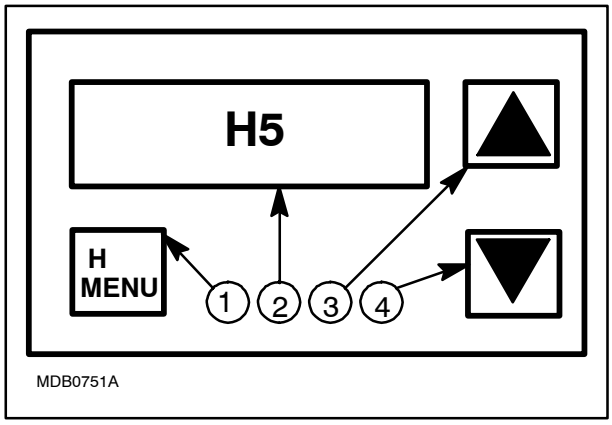
   Remember that after the HF MENU, the count restarts from HH.

   After a brief pause (2 seconds) the ECU enters the procedure of the selected menu.

   Explanations of the relative menus are noted on the following pages.

   If the operator presses key (1) whilst an H menu is in use, the menu is abandoned and the display (2) returns to the HH selection phase.

   If the H code does not correspond with an active H menu, the display (2) returns to HH and waits for an ulterior selection.



52

6. Turn the switch (1) to A to stop the engine and memorize the modified values **waiting for approx. 5 seconds**.

NOTE: *The functional software is always disabled when the CDU is connected to the diagnosis connection, unless otherwise specifically noted. Consult the description of the individual HH menus in order to understand why the functional software is disabled.*

The CDU **294084** gives access to the following menus:

H1 - HYDRAULIC CLUTCH CALIBRATION

H2 - HYDRAULIC CLUTCH CALIBRATION VALUE DISPLAY

H3 - SYSTEM CONFIGURATION

H4 - SOFTWARE REVISION LEVEL

H5 - CONTROL SWITCH DIAGNOSTICS

H6 - CLUTCH FILL TIME MODIFICATION AND DISPLAY

H8 - DELETE DATA SAVED IN THE NON-VOLATILE MEMORY (EEPROM)

H9 - VOLTMETER FUNCTIONS

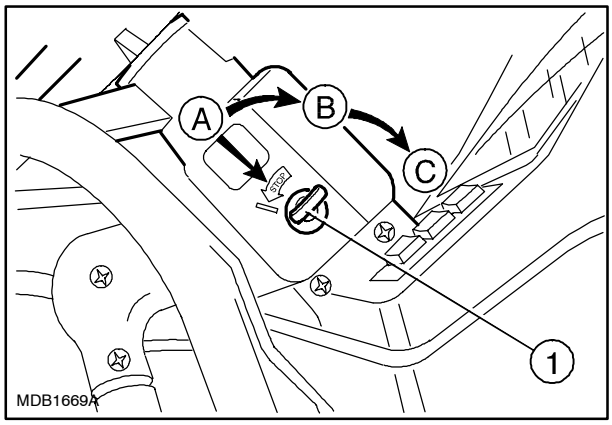
HA - CLUTCH PEDAL POSITION AND NEUTRAL SWITCH DISPLAY

HC - TRANSMISSION OIL TEMPERATURE DISPLAY

HE - GEAR CHANGE ADJUSTMENT

HF - FAULTS SAVED IN THE ECU NON-VOLATILE MEMORY

NOTE: *The tractor can only be used in the H6, H9, HA, HC and HE menus.*
Whilst other menus are being used the transmission is disabled.
If tractor movement is detected whilst these menus are in use, the menu will be interrupted and transmission will be enabled; to re-enter the HH MENU, stop the tractor and press key (1, fig. 54).
To exit from an active MENU, press key (1, fig. 54) to return to the HH MENU.
If the menu allows tractor movement, stop the tractor (speed = 0).



53

CAUTION

Park the tractor on level ground in an unobstructed area (in case of sudden movement).

Engage the handbrake, switch off all electrical switches and the air conditioning system, if on.

Set the Shuttle control lever in neutral, the hydraulic lift lower arms down, the remote control valve levers in neutral and switch off the engine.

Put safety wedges under the front and rear wheels.

Check that the transmission oil temperature is between 68 to 122 °F (20 to 50 °C).

Unless otherwise specified, the levers:
- Shuttle),
- Gear shift,
- Range gear,
- creeper,

are in the NEUTRAL position.

H1 - CALIBRATION OF CLUTCHES A, B, C and D

The H1 menu provides access to Power Shuttle clutches (A and B) and Dual Command (2 Speed Power Shift) (C and D) calibration, reducing the engine speed when the clutches start engaging by transmitting a torque.

- Ensure that the parking brake is engaged.
- Press pushbutton (1) and, with key (1, fig. 53), start the engine.
- Select the **H1** menu, as described on page 29.
- The display will show **CALIBR.**

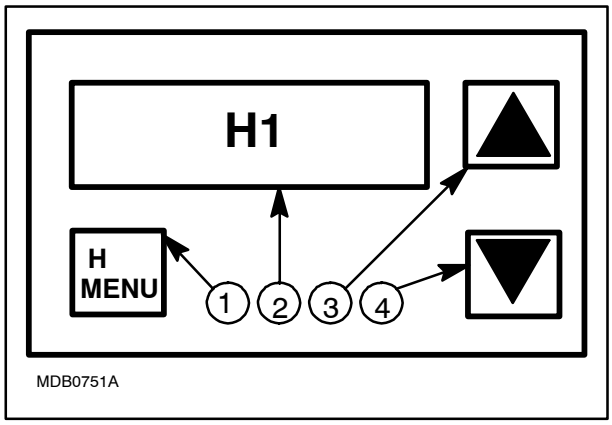
CALIBR.

then

T = 69.8 °F (21 °C)

- Press the clutch pedal fully down.
- Select the fast gear range and first gear.
- Position the Power Shuttle lever in Forward.
- Release the clutch pedal slowly, the tractor should not move.
- bring the engine revs to 1200 to 1400 rpm.

While the display shows the temperature, the clutch to be calibrated can be selected.



54

CLUTCH A CALIBRATION

- Select the clutch to be calibrated using key ▲ (3).
- If the temperature is less than 68 °F (20 °C) the following message will be displayed :

  COLD.OIL

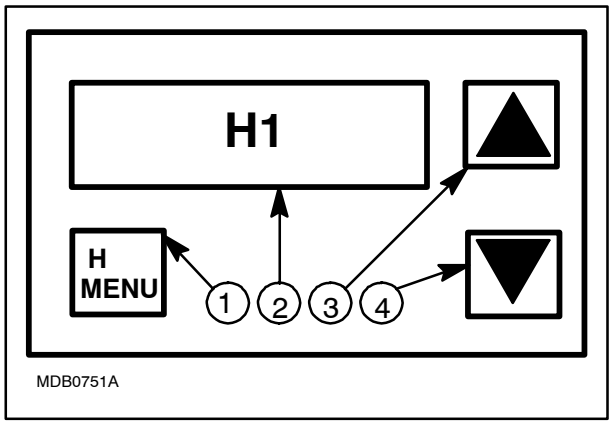
  calibration can be carried out if the temperature is > 50 °F (10 °C).
- Press and hold down key ▼ (4) to calibrate clutch A.

  A **U**-type error will be displayed if a calibration sequence error has been detected.
- If there are no faults or if the problems have been resolved, the following message will be displayed:

  AUX.ON

  and then:

  STAB.RPM
- After a few seconds the display will show the initial current in milliAmpere (for a few seconds), e.g:



55

A: xxxmA

where xxx is a value between 0 to 999 mA.

The number displayed and the current will increase rapidly, until the completion of the clutch calibration procedure; i.e.: until engine revs drop to 50 rpm.

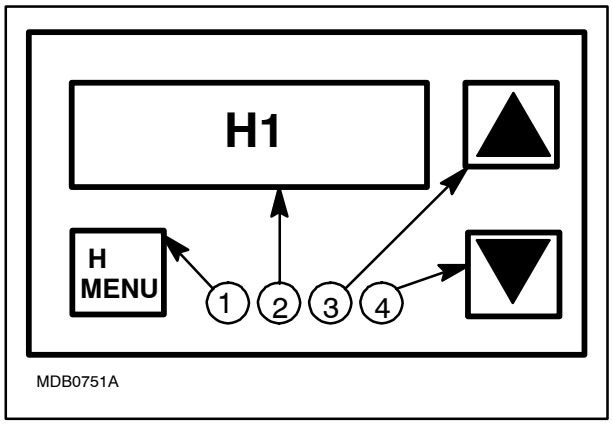
As long as the pushbutton ▼ (4) remains pressed, the display will show the calibration value (flashing); for example:

A: 300mA

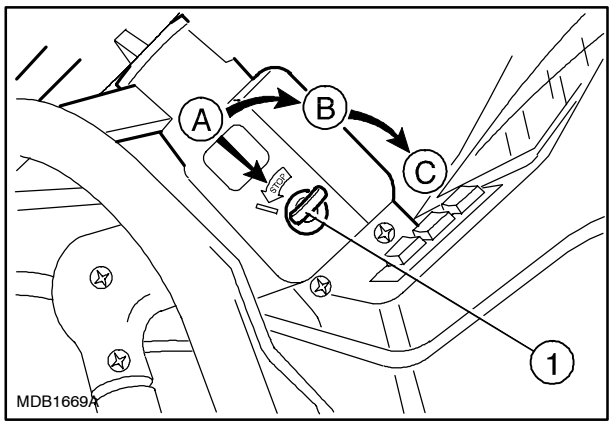
- Release pushbutton ▼ (4), the display will show clutch B.
- repeat the aforementioned operation on clutches B, C and D.
- during the previously described clutch calibration operation the clutch can be selected by pressing the key ▲ (3).

  Each of the clutches can now be calibrated or, to end the procedure, proceed as follows.
- Switch off the engine by turning switch (1) to A (OFF), hold in this position for at least 2 seconds to save the calibration values.

NOTE: *The rear transmission revs (wheels), the clutch pedal position, the Shuttle lever position, the gear shift and Range levers are constantly checked. Calibration can not proceed if: the tractor is moving, the Shuttle lever is not in neutral, the clutch pedal is not released (raised) and the range and gear levers are not in neutral.*
If an anomalous condition is detected during calibration, the display will show the relative fault code with the flashing alarm lamps, if there is an anomaly in calibration, a ***U****-type fault code will be displayed.*
Refer to the following list for ***U****-type faults.*



56



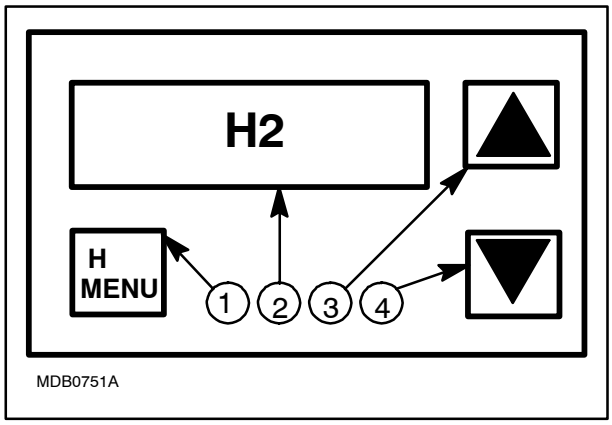
57

UXX **ERROR CODES**

CODE	CAUSE
U19	Oil temperature below 50 °F (10 °C) (*).
U20	Incorrect starting procedure. Press and release the clutch pedal.
U21	Engine speed below 1200 rpm.
U22	Engine speed above 1400 rpm.
U23	Shuttle control lever in neutral.
U24	Range gear lever in neutral.
U25	Main gear lever in neutral.
U26	Clutch pedal is not fully raised.
U31	Wheel speed read: the tractor is moving.
U33	Parking brake disengaged.
U34	Driving seat circuit open.
U36	Clutch calibration value too high.
U37	Clutch calibration value too low.

(*) - Between 50 °F (10 °C) and 68 °F (20 °C) and above 212 °F (100 °C) calibration is carried out by holding down key (4, fig. 56) ▼ on instrument **294084** even if the display shows "**COLD OIL**" or "**HOT OIL**".

H2 - CLUTCH CALIBRATION VALUE DISPLAY - A, B, C and D



58

Select the **H2** menu, as described on page 29.

It is not necessary to start the engine.

This menu displays the calibration values of the solenoid valves of the hydraulic clutches of the Power Shuttle (A and B) and Dual Command (2 Speed Power Shift) (C and D).

The calibration values, in milliAmpere, are shown on the display (2).

Initially, the display shows the calibration value of Power Shuttle clutches A and B, then Dual Command (2 Speed Power Shift) clutches (C and D).

Use pushbuttons ▲ (3) and ▼ (4) to select clutches A, B, C and D.

The calibration values are in milliAmpere with 3 digits and are used one at a time:

A = **xxxmA** or **B** = **yyymA**

or

C = **kkkmA** or **D** = **wwwmA**

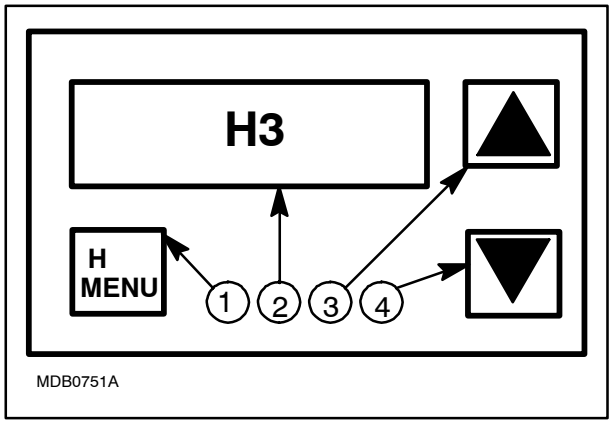
where xxx, yyy, kkk and www are the 4 calibration values in milliAmpere (mA).

The prescribed calibration values are:

Clutch A **230** to **480** mA
Clutch B **230** to **480** mA.
Clutch C **200** to **480** mA
Clutch D **200** to **480** mA

Turn switch (1, fig. 61) to A (OFF).

H3 - SYSTEM CONFIGURATION



59

This section is used to read or modify ECU configuration. The configuration is saved in the Non-Volatile Memory (NVM) and is automatically registered the first time the tractor is used.

However, for maintenance purposes, this menu allows the configuration saved in the NVM to be viewed and manually modified.

- Select the **H3** menu, as described on page 29, the display (2) shows the configuration in use.
- It is not necessary to start the engine.
- **NONE** = Only occurs if the module has not yet been used: after an EEPROM delete operation (H8).
- **18.64 mph (30 km/h)** = use with 18.64 mph (30 km/h) transmission.

- **24.85 mph (40 km/h)** = use with 24.85 (40 km/h) transmission.
- To exit from this menu without modifying the configuration mode, press the H MENU key (1), the display (2) shows:

  HH MENU

To change the configuration mode, proceed as follows.

- Use key (3) to change the mode displayed: each time the key is pressed, the display (2) changes, passing from the **NONE** to **18.64 mph (30 km/h)** to **24.85 mph (40 km/h)** and then to **NONE** mode once more.

NOTE: *If the configuration 18.64 mph or 24.85 mph (30 km/h or 40 km/h) is not correct, indicator lights (1 and 2, fig. 85) will be the opposite to the actual operation.*

- When the required mode is displayed, press and hold down key ▼ (4) for at least 5 seconds.
- While key ▼ (4) is pressed, the display (2) carries out a reverse countdown of the remaining time, at 1 second pauses, starting from:

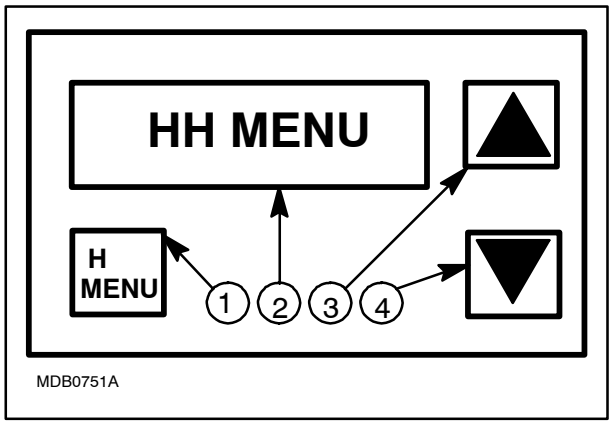
  STORE 5s
  STORE 4s
  STORE 3s
  STORE 2s
  STORE 1s
- After 5 seconds, the display (2) shows:

  STORED
- Release key (4)

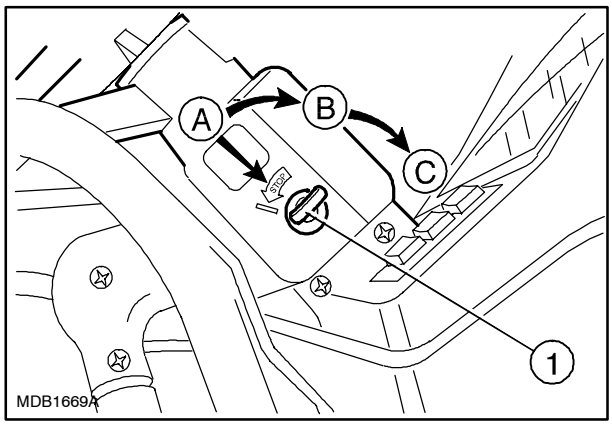
NOTE: *If button ▼ (4) is released whilst the display (2) is carrying out the reverse countdown, the display returns to the mode selected.*

- Turn switch (1) to A (OFF) and wait for at least 2 seconds, this is the time required to save the new configuration.

NOTE: *Selecting the **NONE** mode results in ECU auto-reconfiguration at the next start up. Follow the instructions shown on page 48 to ensure correct configuration.*
Even if any of the available modes can be selected, incorrect mode selection can lead to an illuminated indicator fault or inefficient tractor operation.



60



61

ERROR MODE SELECTION

The ERROR MODE function is used by the system to store the critical errors that may disable the hydraulic transmission.
These errors can be displayed diversely, according to the mode selected:

USER
LIVE
FACTORY

USER ERROR MODE, LIVE ERROR MODE or FACTORY Selection (from the H3 menu)

- press and hold the clutch pedal
- Move the Power Shuttle lever forward
- the display will show:
  USER, **LIVE** or **FACTORY**
- press key (3) ▲ or (4)▼ and select one of the aforementioned modes
- the display shows the faults stored
- save the mode by pressing and holding key (4) ▼ until the following sequence is shown on the instrument display:

  STORE 5s
  STORE 4s
  STORE 3s
  STORE 2s
  STORE 1s

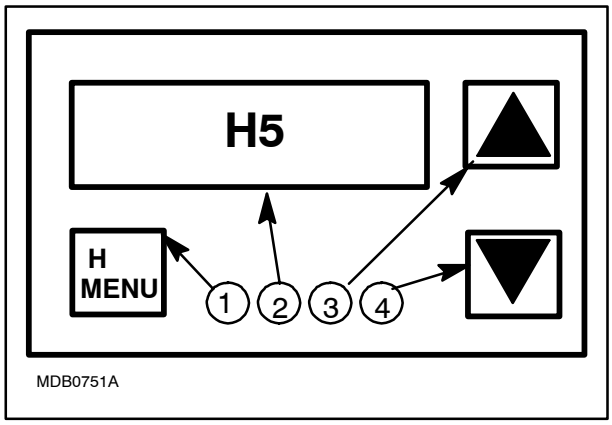
- After 5 seconds, the display (2) shows:

  STORED

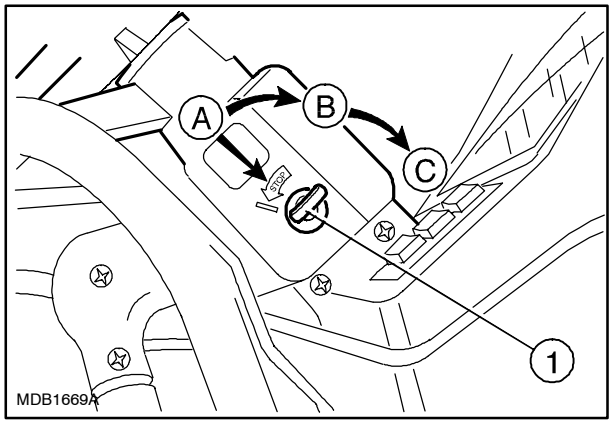
- Release key (4)

NOTE: *If button ▼ (4) is released whilst the display (2) is carrying out the reverse countdown, the display returns to the mode selected.*

- Move switch (1) to A (OFF) and wait for at least 2 seconds.



62



63

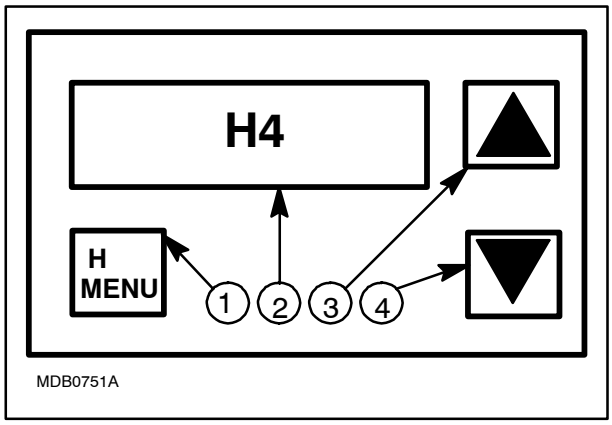
H4 - SOFTWARE REVISION LEVEL

The H4 menu displays the revision level of the software installed in the ECU, as follows.

- It is not necessary to start the engine.
- Select the **H4** menu, as described on page 29, the display (2) shows the following information.
  - Product identity **MD**
  - software revision level (release) **03.04**
  - hardware level **04.00**
  - not used **00**
- The parameters are shown in sequence, displayed for two seconds. After the last display, the module returns to the HH level.

The hardware level refers to the ECU hardware version and is saved with the ECU boot-loader: a new functional software download will not modify this value.

- Turn switch (1, fig. 61) to A (OFF).



64

H5 - CONTROL SWITCH DIAGNOSTICS

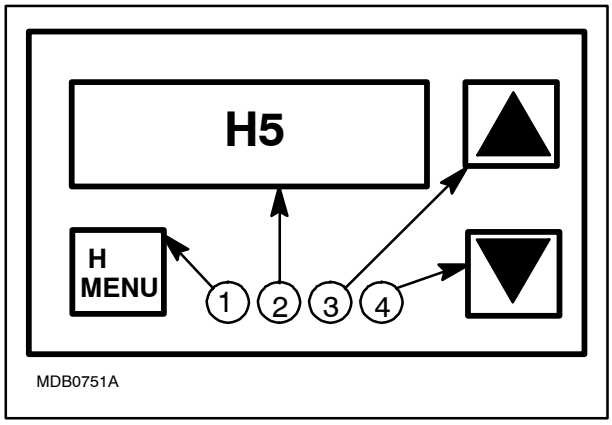
This module is requested by the Diagnostics Menu to check for any control module switch and analog input circuit status changes on the ECU.
A status change, for the analog inputs, means that a fixed threshold has been exceeded.

The display (2) shows a **d** and a number each time a status change occurs.

The number indicates on which circuit the status change has taken place.

If the same circuit has two consecutive status changes, the message on the display (2) changes to **d0** when the second change occurs. This menu also checks compatibility problems on the Forward, Neutral and Reverse push-buttons.

The neutral push-button cannot be checked separately with the number **d**, as the operator cannot cause a status change on the neutral switch without simultaneously changing the Forward or Reverse switches.



65

If the Shuttle lever is moved with the clutch raised, the neutral switch will also create a status change on the 12VD line used to control the clutch pedal.

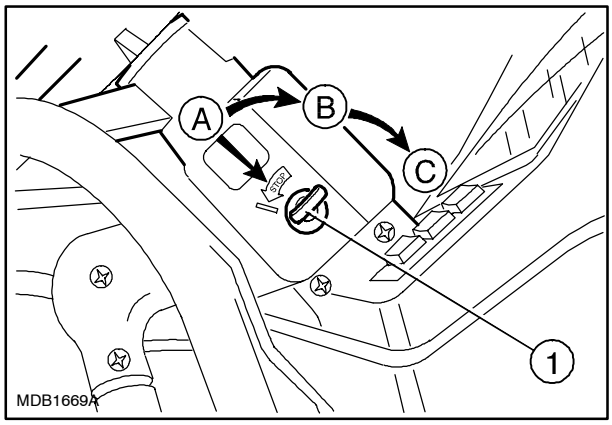
As a result of the interaction between these push-buttons, consider the following:

- The Forward and Reverse push-buttons must be checked with the clutch pedal lowered.
- The clutch pedal push-button must be checked with the Shuttle lever engaged.
- If the starter key (1) is turned to position C to start the engine, with the Shuttle lever in the neutral position and the clutch pedal lowered (normal starting procedure), a fault on the push-buttons may occur (only in the diagnostics mode).

When there is a status change on the clutch pedal push-button (the pedal is released), the clutch pedal potentiometer calibration values are checked, together with push-button adjustment.

To check efficiently, proceed as follows:

- Select the **H5** menu, as described on page 29 and with the clutch pedal fully raised.
- Fully press down the clutch pedal and hold down for at least 1 second.
- Release the clutch pedal slowly (taking at least 2 seconds to move from the *pedal pressed* to the *pedal released position*.



66

n.	Switch or analog input
d20	Clutch pedal potentiometer position.
d21	Clutch pedal neutral push-button (12VD).
d22	Reverser lever Forward position push-button.
d23	Reverser lever Reverse position push-button.
d24	Gear lever LOW selection push-button.
d25	Gear lever HIGH selection push-button.
d29	Oil temperature sensor.
d33	Gear position push-button.
d34	Range position push-button.
d36	Operator seat switch.
d39	Parking brake lever.
d42	Clutch A oil pressure sensor.
d43	Clutch B oil pressure sensor.
d50	Range control lever in 2nd or in 3rd.

This menu can be used to check the cab with the following procedure.

Action	Description	Display
1	Enter the H5 menu with the clutch pedal released and the Shuttle lever in Forward.	d0
2	Slowly press the clutch pedal (time > 2 seconds). The potentiometer status change should be read first, followed by the push-button.	d20 d21
3	With the clutch pedal lowered, move the Shuttle lever from the Forward position to neutral, to check the Forward selection push-button.	d22
4	Leave the Shuttle lever in the neutral position for at least 1 second to check for disagreement between the Forward/Neutral/Reverse push-buttons (E59).	(d22)
5	Holding down the clutch pedal, move the Shuttle lever from the neutral position to Reverse, to check the relative push-button.	d23
6	Release the clutch pedal slowly (time > 2 seconds). The push-button status change should be read first. Clutch pedal calibration is checked (E10, E11 and E12). Clutch pedal push-button adjustment is checked (E47 and E48). Finally, the potentiometer status change is read.	d21 d20
7	Press the LOW push-button.	d24
8	Release the LOW push-button.	d0
9	Press the HIGH push-button.	d25
10	Release the HIGH push-button.	d0
11	Carry out a status change on the gear lever.	d33
12	Carry out a status change on the Range lever.	d34
13	Carry out a status change on the operator seat switch.	d36
14	Carry out a status change on the parking brake lever.	d39
15	Carry out a status change on the Range lever.	d50

H6 - CLUTCH FILL TIME MODIFICATION AND DISPLAY - A, B, C and D

In this menu the transmission is enabled.

- It is not necessary to start the engine.

With this menu the fill time can be programmed and checked.

- Select the **H6** menu, as described on page 29, the display (2) shows the letter of the relative clutch and the fill time:

  A = 30ms

- With the clutch pedal pressed or the Shuttle lever in neutral, use push-buttons ▲ (3) and ▼ (4) to increase or decrease the fill time within the range of values between 30 ms and 150 ms (variation of 10 ms).

By decreasing the fill time, engagement will be less abrupt; vice versa, by increasing the time the solenoid valve will be open for longer, therefore engagement will be more abrupt.

By releasing the clutch pedal or engaging the Shuttle lever (with the clutch pedal released) the effective fill time can be checked.

Save the set value by positioning the Power Shuttle control lever (1) Forward, with the clutch pedal raised.

- Position the Power Shuttle lever in neutral.

Select clutches (B, C and D) by pressing the clutch pedal fully down and moving the Shuttle control lever from Neutral to Forward, then to Neutral once more and select clutch B.

- Repeat the aforementioned operation on clutch A.

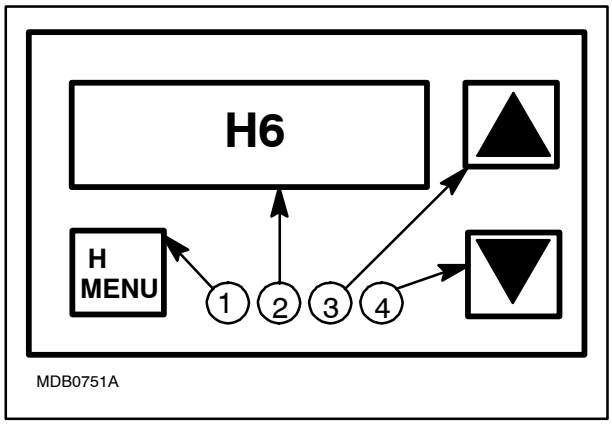
For clutches C and D, carry out the aforementioned operations described for clutches A and B.

- Move switch (1) to A (OFF).

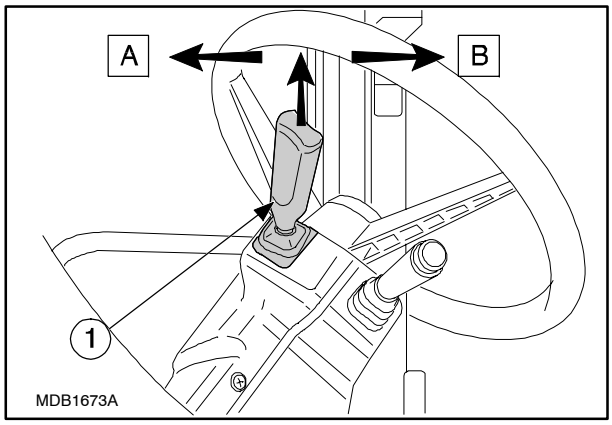
CAUTION

The first fill time, after adjustment, may not be effective: try at least twice before evaluating the value.

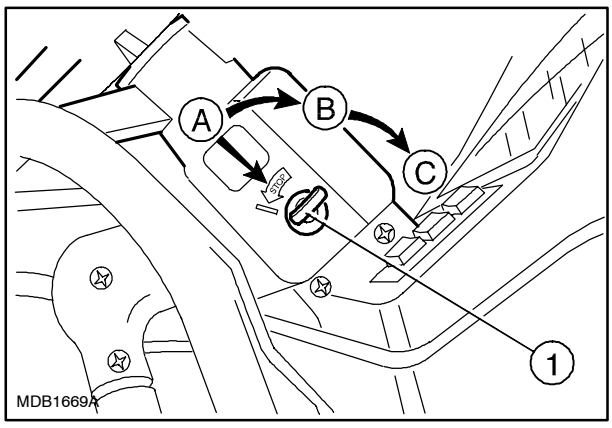
NOTE: *The tractor can only move in forward gear, reverse gear is not permitted with this menu.*



67



68



69

H8 - DELETING DATA FROM THE NON-VOLATILE MEMORY (NVM) (EEPROM)

This menu sets the Non-Volatile Memory values (NVM) (EEPROM=Electrically Erasable Programmable Read Only Memory) on pre-set values. The NVM is a memory storing application, where configuration parameters and all faults are saved. The memory is saved even if the module is without a power supply, i.e.: the battery is disconnected.

This menu should only be used when a module is transferred from one tractor to another.

- It is not necessary to start the engine.
- Select the **H8** menu, as described on page 29, the display (2) shows the following information.

  ERASE?
  - To interrupt the deleting operation, press the H MENU key (1).
- To proceed, press key ▼ (4) and hold down for 5 seconds.

  Whilst key ▼ (4) is pressed, the display (2) carries out a reverse countdown of the remaining time, at 1 second pauses.

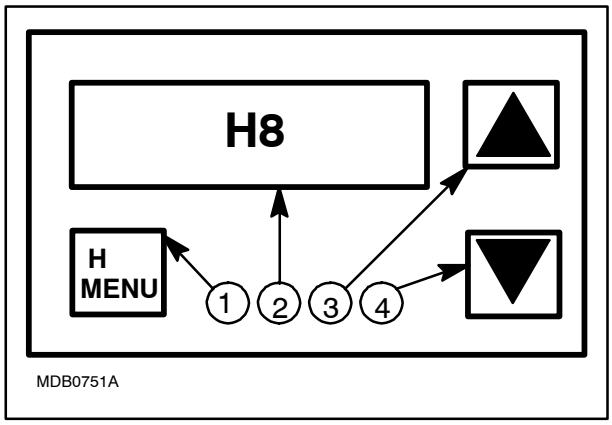
  ERASE 5s
  ERASE 4s
  ERASE 3s
  ERASE 2s
  ERASE 1s
- After 5 seconds, the display (2) shows:
  ERASED

On completion of the deleting procedure, release key ▼ (4).

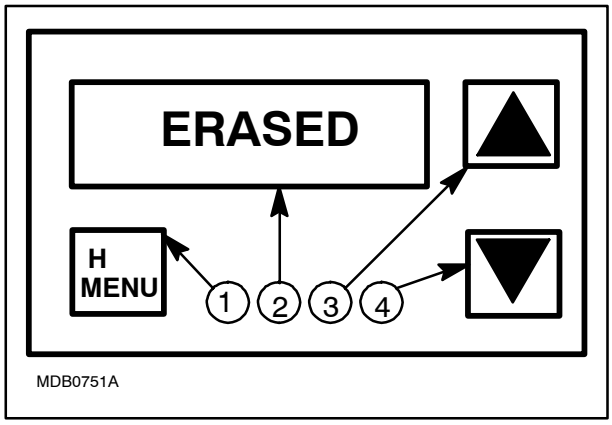
NOTE: *If key (4) is released during the reverse countdown on display (2), the display returns to the start of the menu, displaying:* ***ERASE?****.*

- Move switch (1) to A (OFF) for at least 5 seconds.

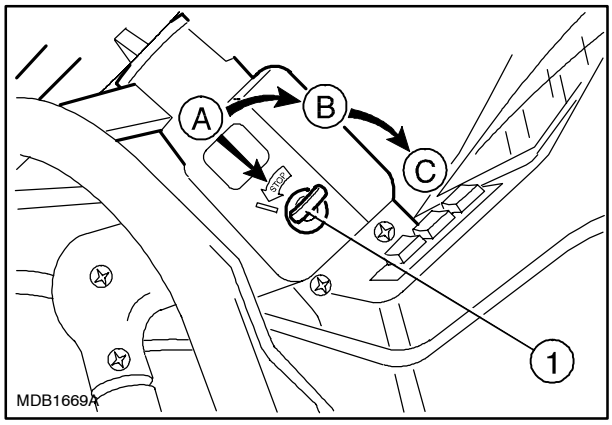
NOTE: *By deleting the NVM, all the saved configuration information is also deleted, which results in ECU auto-reconfiguration at the next start up. Follow the instructions shown on page 48 to ensure correct configuration.*



70



71



72

H9 - VOLTMETER FUNCTIONS

This menu checks the power supply voltage status, the frequency and the solenoid valve circuits.

It is not necessary to start the engine.

NOTE: *In this menu, the transmission is enabled.*

The display (2) shows a channel number followed by a typical value (a numerical value between 0-1023) corresponding to the unit of measurement.

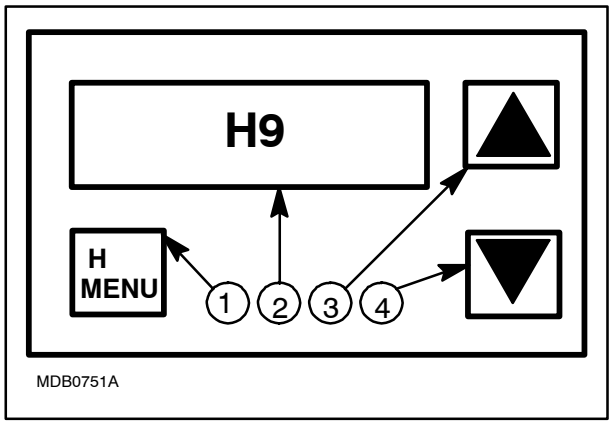
Example: **15** → **1023**

where:

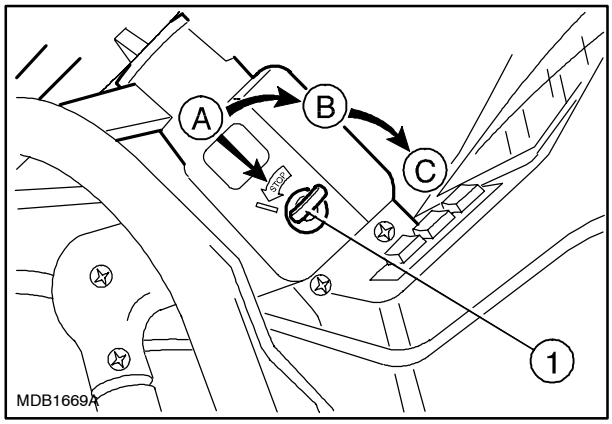
15 channel number.

1023 typical value corresponding to a unit of measurement.

- Select the **H9** menu, as described on page 24, the display (2) shows the following information.
- The channels can be shown on the display (2) by pressing key ▲ (3) to increase the channel number, or key ▼ (4) to decrease the channel number.
- Move switch (1, fig. 72) to A (OFF).



73



74

Channel	Description	Unit of measurement	Value
1	Clutch pedal potentiometer	Counts (ADC)	> 542 pedal released < 38 pedal pressed
2	Transmission oil temperature	Counts (ADC)	394 to 532 at 0 °C 192 to 258 at 86 °F(30 °C) 116 to 156 at 140 °F(60 °C) 45 to 61 at 194 °F(90 °C)
3	ECU power voltage (+ 12VF)	Counts (ADC)	428 (9V battery) 762 (16V battery)
4	ECU power voltage (+ 12VD)	Counts (ADC)	428 (9V battery) (1) 762 (16V battery) (1) 0 to 95 (2)
7	Clutch B voltage	Counts (ADC)	350 to 550 (3)
8	Clutch A voltage	Counts (ADC)	350 to 550 (3)
9	Reverser Forward lever switch voltage	Counts (ADC)	170 (3) (21 to 323) 480 (4) (326 to 900)
10	Reverser Reverse lever switch voltage	Counts (ADC)	170 (3) (21 to 323) 480 (4) (326 to 900)
11	Wheel speed sensor (direct current)	Counts (ADC)	600 (5) (536 to 831)
12	Clutch C voltage	Counts (ADC)	350 to 550 (3)
13	Clutch D voltage	Counts (ADC)	350 to 550 (3)
14	5V sensor voltage	Counts (ADC)	670 at 5V (521 to 849)
15	Not used		
16	Gear switch voltage	Counts (ADC)	165 (10) (21 to 323) 470 (11) (324 to 900)
17	Range switch voltage	Counts (ADC)	165 (10) (21 to 323) 470 (11) (324 to 900)
18	Range switch voltage	Counts (ADC)	340 (10) (21 to 514) 680 (11) (515 to 900)
19	Wheel speed sensor frequency	Hz	0 to 3000
20	Engine speed sensor frequency	Hz	350 to 2000
21	Tractor speed	km/h	according to the tyres fitted
22	Engine Speed	rev/min	0 to 3000
23	Not used		
24	Not used		

ADC = Analog/digital converter. - 1) Clutch pedal released and Shuttle lever engaged. - 2) Clutch pedal pressed or shuttle in neutral. - 3) Switch released. - 4) Switch pressed. - 5) Tractor stationary. - 6) Dual Command (2 Speed Power Shift) mode selected. - 7) Dual Command (2 Speed Power Shift) mode not selected. - 8) Shuttle lever engaged. - 9) Shuttle lever in neutral. - 10) Gear engaged. - 11) Gear in neutral.

HA - CLUTCH PEDAL POSITION AND NEUTRAL SWITCH DISPLAY

In this menu the transmission is enabled.

It is not necessary to start the engine.

This menu allows the tractor to be moved whilst showing, on the CDU display, the clutch pedal position and the clutch switch status.

The pedal position is expressed as a percentage of the entire stroke, whilst the switch condition is indicated with **ON** and **OFF**.

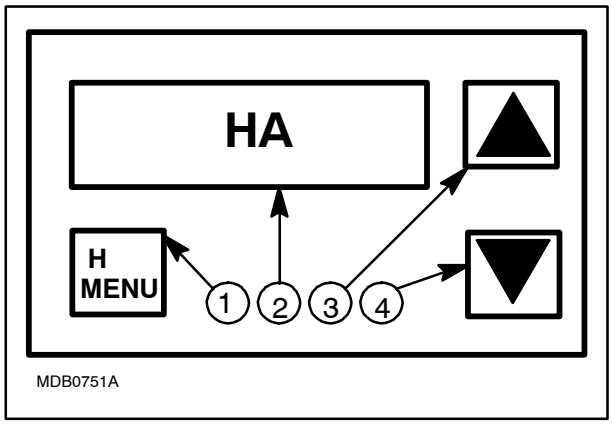
- Select the **HA** menu, as described on page 29, the display (2) shows:

  xxx% ON

  or

  xxx% OFF

  where xxx is the percentage of the clutch pedal stroke, from 0 to 100%.
- Move switch (1, fig. 77) to A (OFF).



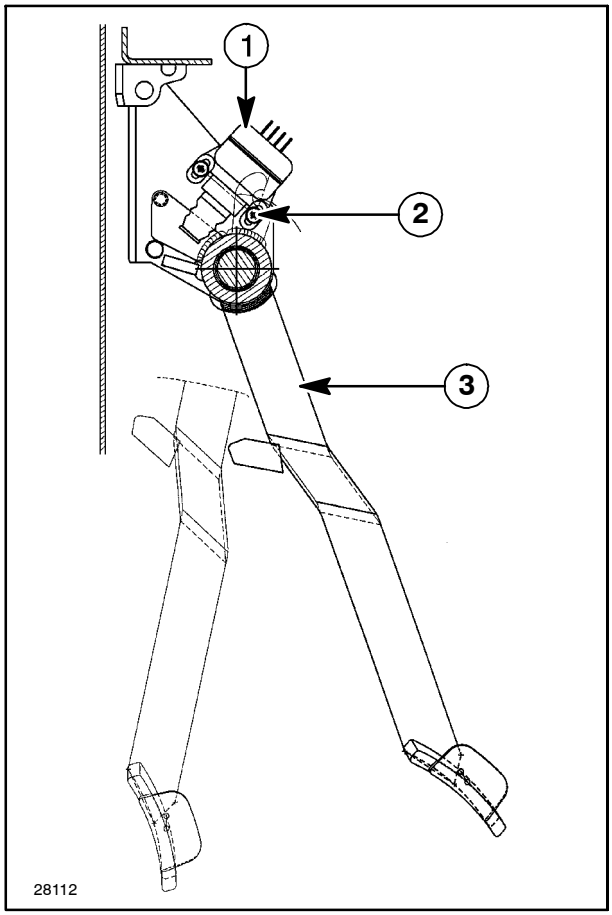
75

Clutch pedal switch adjustment

The switch will require adjustment in the following cases:

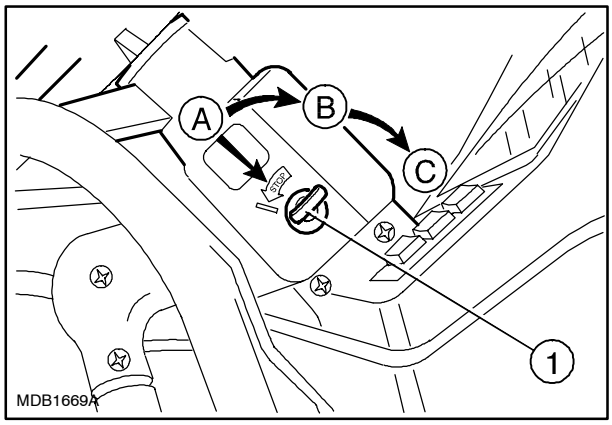
- Switch replacement (1).
- Alarm lamp indicating a switch fault.
- Move the Shuttle lever to the Forward position.
- Select the **HA** menu, as described on page 29.
- Press the clutch pedal (3) fully down, check that the value is ~ 0%, release the pedal (3) and check that the value is ~ 100%.
- Press the clutch pedal (3) slowly, the switch will change status from ON to OFF with a value greater than 5%.
- Release the clutch pedal slowly, the switch changes status from OFF to ON with a value less than 15%.

To adjust: loosen the bolts (2) and move the switch (1) in the relative slot; tighten the bolts (2) and check the adjustment values again.



76

- Press and release the clutch pedal (3. fig. 76) and check that the values in the ON and OFF positions are within the set limits:
  from ON to OFF **> 5%**
  from OFF to ON **< 15%**
- Turn the switch (1) to A (OFF) to save the auto-configuration.



77

HC - TRANSMISSION OIL TEMPERATURE

The HC menu displays the value in °C of the transmission oil temperature on the instrument display, as follows.

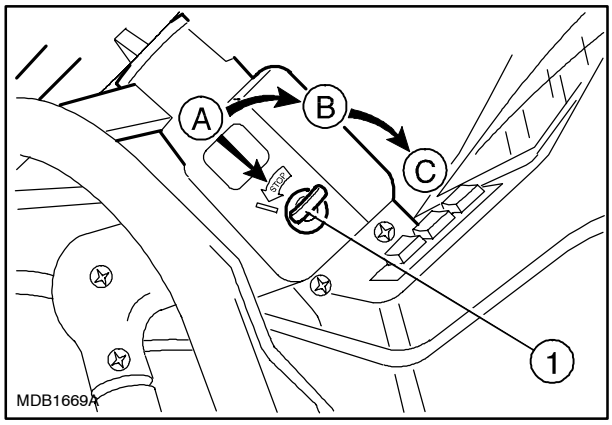
It is not necessary to start the engine.

In this menu the transmission is enabled.

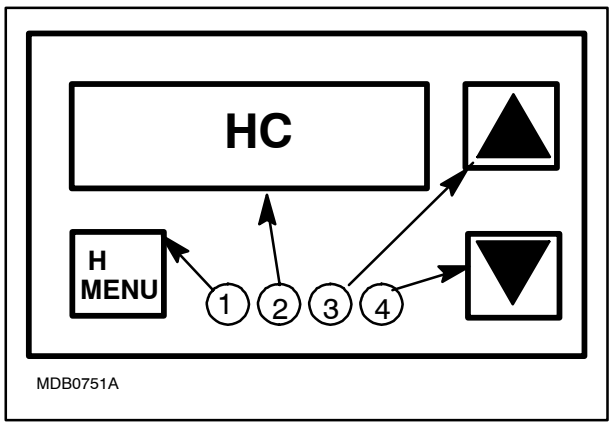
- Select the **HC** menu, as described on page 24.
- The instrument display shows the value in °C of the transmission oil temperature, for example:

  T= 69.8 °F (21 °C)

- The temperatures can be read between -40° and 248 °F (-40° and 120 °C).
- Move switch (1 fig. 78) to A (OFF).



78



79

HE - GEAR CHANGE ADJUSTMENTS

This program defines the gear change speed threshold.

Gear changes carried out above this value use a faster engagement table than that used for gear changes under this value.

It is not necessary to start the engine.

- Select the **HE** menu, as described on page 29.
- 3 values can be selected;

LOW [approx. 2.9825 mph (4.8 km/h)]

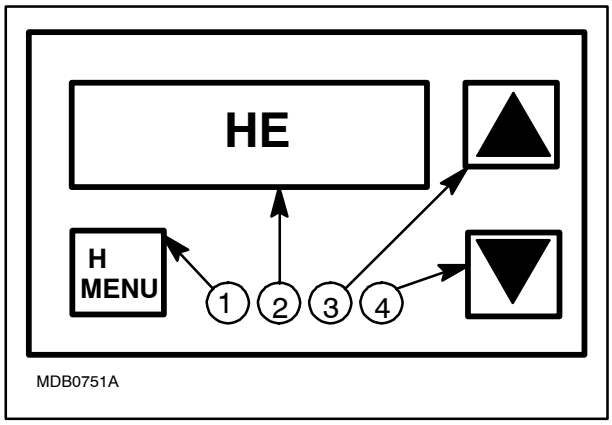
MID [approx. 3.9767 mph (6.4 km/h)]

HIGH [approx. 8.0156 mph (12.9 km/h)]

- The menu displays the selected threshold, e.g.:

WST = HIGH

- Use push-buttons ▲(3) and ▼ (4) to modify the selected value.
- Move switch (1, fig. 78) to A (OFF).



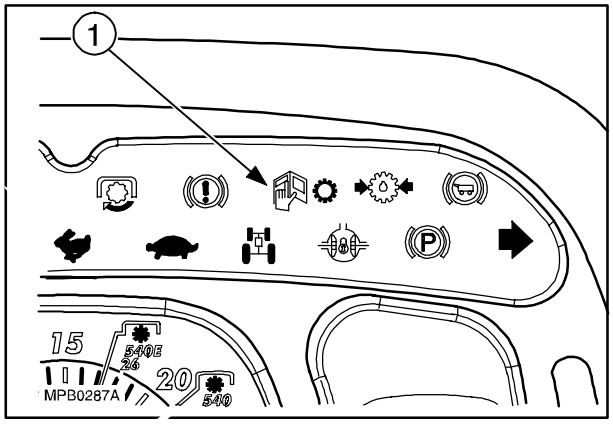
80

HF - ERRORS STORED IN THE NON-VOLATILE STORAGE OF THE ECU

When a fault is detected it is stored in the ECU non-volatile memory and signalled by the indicator lamp (1).

It is not necessary to start the engine.

- Select the **HF** menu, as described on page 29.



81

- The display (2) shows the last fault saved.

  Example: **E(9) = 39**

  E = Fault.

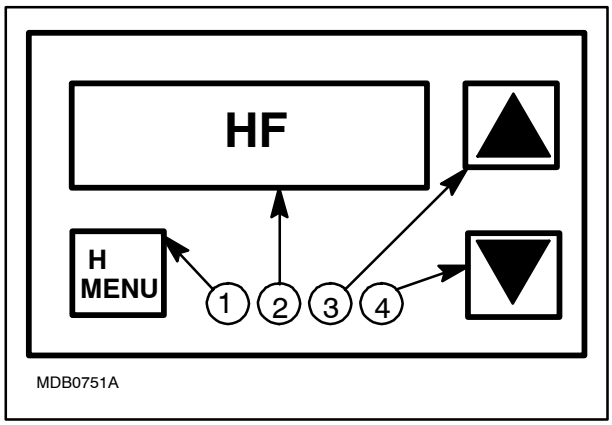
  (9) = Progressive memory cell.

  39 = Fault code.

- Use key ▼ (4) or ▲ (3) to display any faults saved in cells 1 to 9.

When no faults are saved, the display will show:

example: **E(1)=00.**



82

- To proceed, press key ▼ (4) and hold down for 5 seconds.

  Whilst key ▼ (4) is pressed, the display (2) carries out a reverse countdown of the remaining time, at 1 second pauses.

  ERASE 5s

  ERASE 4s

  ERASE 3s

  ERASE 2s

  ERASE 1s

- After 5 seconds, the display (2) shows:

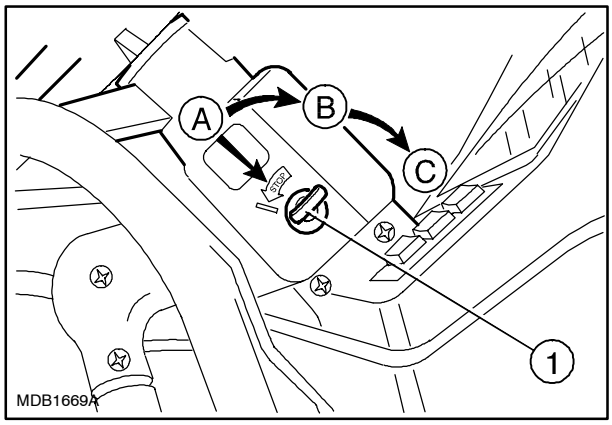
  ERASED

On completion of the deleting procedure, release key ▼ (4).

NOTE: *If key (4) is released whilst the display (2) is carrying out the reverse countdown, the display returns to the current cell of the buffer memory.*

- Move switch (1) to A (OFF).

NOTE: *If the Reverser lever is in neutral or a speed input signal (rpm > 400) is read, the procedure must be interrupted and normal operation must be resumed.*



83

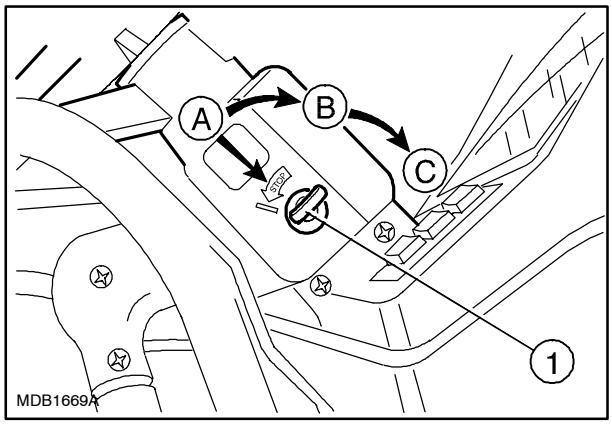
FIRST START-UP

The first start-up procedure must be carried out in the following cases.

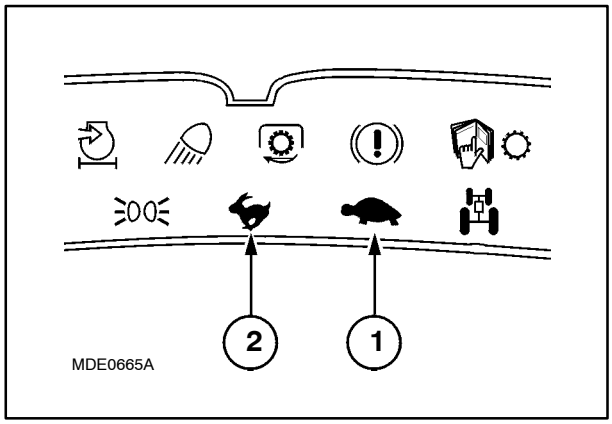
- At the end of the production line.
- Following ECU replacement.
- Following erasure of the Non-Volatile memory (NVM) (see H8 MENU).
- Following manual configuration (see H3 MENU).
- Turn switch (1) to B (ON) without switching on the engine.
- Indicators (1 and 2) will be illuminated (non-flashing), after a few seconds indicator (1, fig. 86) will flash to repeat the recognised configuration code - i.e.: rapid flashing, followed by:

  1 flash Power Shuttle and Dual Command (2 Speed Power Shift).

- Move switch (1) to A (OFF).

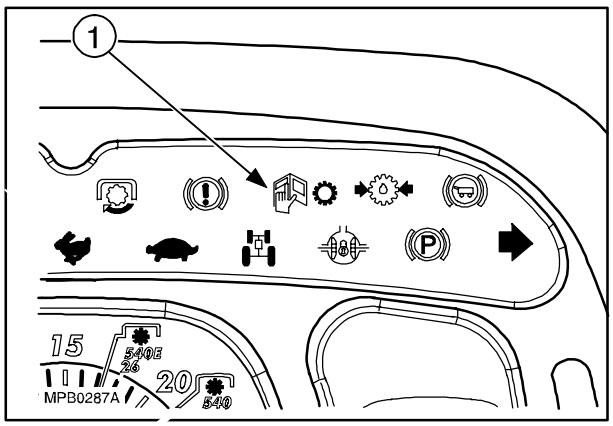


84



85

- Turn the switch (1, fig. 86) onto B.
- At this point the indicator (1) will show fault code 24 (the clutches must be calibrated; carry out the H1 MENU, page 26).



86

DIAGNOSTICS

CAUTION

Notes to help the operator make diagnosis and troubleshooting easier.

1. The measurements taken to read:

   voltage;

   resistance;

   frequency;

   must be carried out with a digital tester.

NOTE: *the resistance values shown are valid for a temperature of 68 °F (20 °C) (ambient temperature). With higher or lower tractor temperatures, the relative resistance values shown in the manual should vary accordingly.*

2. The "short to ground" message refers to a resistance value of less than 5 ohm (Ω).
3. When a fault occurs, before carrying out any kind of service operations, check that the specific connections (ECU, sensors, switches, etc.) are correctly connected.
   A faulty connection could be the cause of incorrect tractor operation.
4. To facilitate problem solving, consult the ECU electrical wiring diagram, shown on page 151.
5. If the ECU needs to be replaced, the following operations must be carried out:

   the **H8 MENU** function (cancellation of the resident non-volatile memory); also check that the self-configuration operation at the first start-up (after ECU replacement) is correct;

   calibration of the hydraulic clutches **H1 MENU** pages 31 and 32.

   other requested calibration operations.

6. There are two types of faults:

   FAULT RESET: the fault will no longer be displayed if the cause has been eliminated or repaired, even without switching off the tractor, but the relative code will be saved in the non-volatile memory (see HF MENU);

   NO FAULT RESET: the fault remains on the alarm lamp when the cause is eliminated or solved. To remove the fault display, stop then restart the tractor. The fault will be saved (as a "no fault reset") in the non volatile memory (see HF MENU).

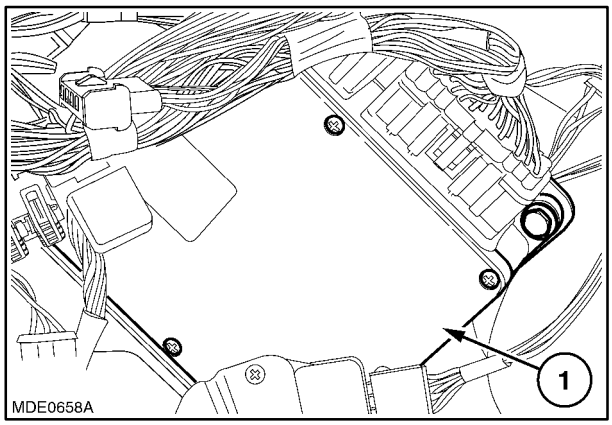
7. The connection references indicate: the wire dimension and colour, and the connection pin number.
   Example: 0.5 AB (2)
   0.5 = wire dimension;
   AB = wire colour;
   (2) = connection pin number.

8. CN1-4 or CN2-25 on connections (148) on the ECU refer to the smaller connection (18 pin) or the bigger connection (36 pin) and the relative pin number.

9. The faults are listed in progressive order.

ECU LOCATION

The ECU (1) is located to the left of the steering column and can be accessed by removing the relative left-hand guard.



FAULT CODE 11

The wiring on potentiometer (1) on the clutch pedal is interrupted or in short to ground, or the potentiometer is faulty.

The clutch pedal does not work and the HIGH and LOW lamps flash alternately.
The tractor can be moved by using the Power Shuttle lever.

Replace the potentiometer.

Turn the starter key to the OFF position. Remove the left-hand panel under the dashboard. Is the potentiometer wiring (1) on the clutch pedal disconnected?

NO

Disconnect connection (129) and, using a digital tester, measure the resistance between terminals (1) and (2) on the potentiometer (with the pedal released). Is the reading ~ 3.5 kΩ?

NO

YES

Connect the wiring.

YES

Is wire (S) on the wiring on connection (129) in short circuit to ground?

NO

YES

Disconnect connections (148) on the ECU). Check the wiring between pin CN2-24 (S) on connections (148) and the wiring on connection (129) on the potentiometer. Eliminate the cause of the short to ground.

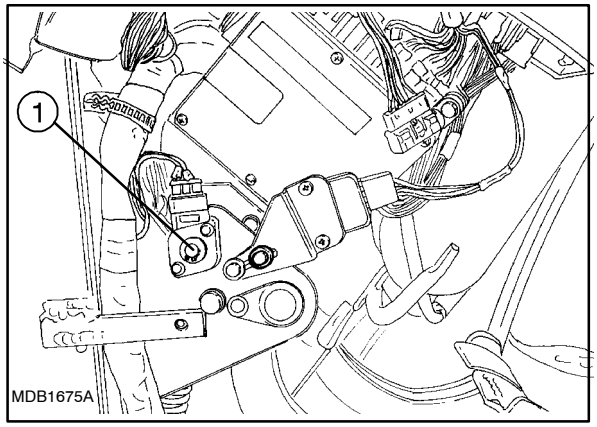
Is there electrical continuity between pin CN2-24 (S) on connections (148) and pin 2 on the wiring on connection (129)?

NO

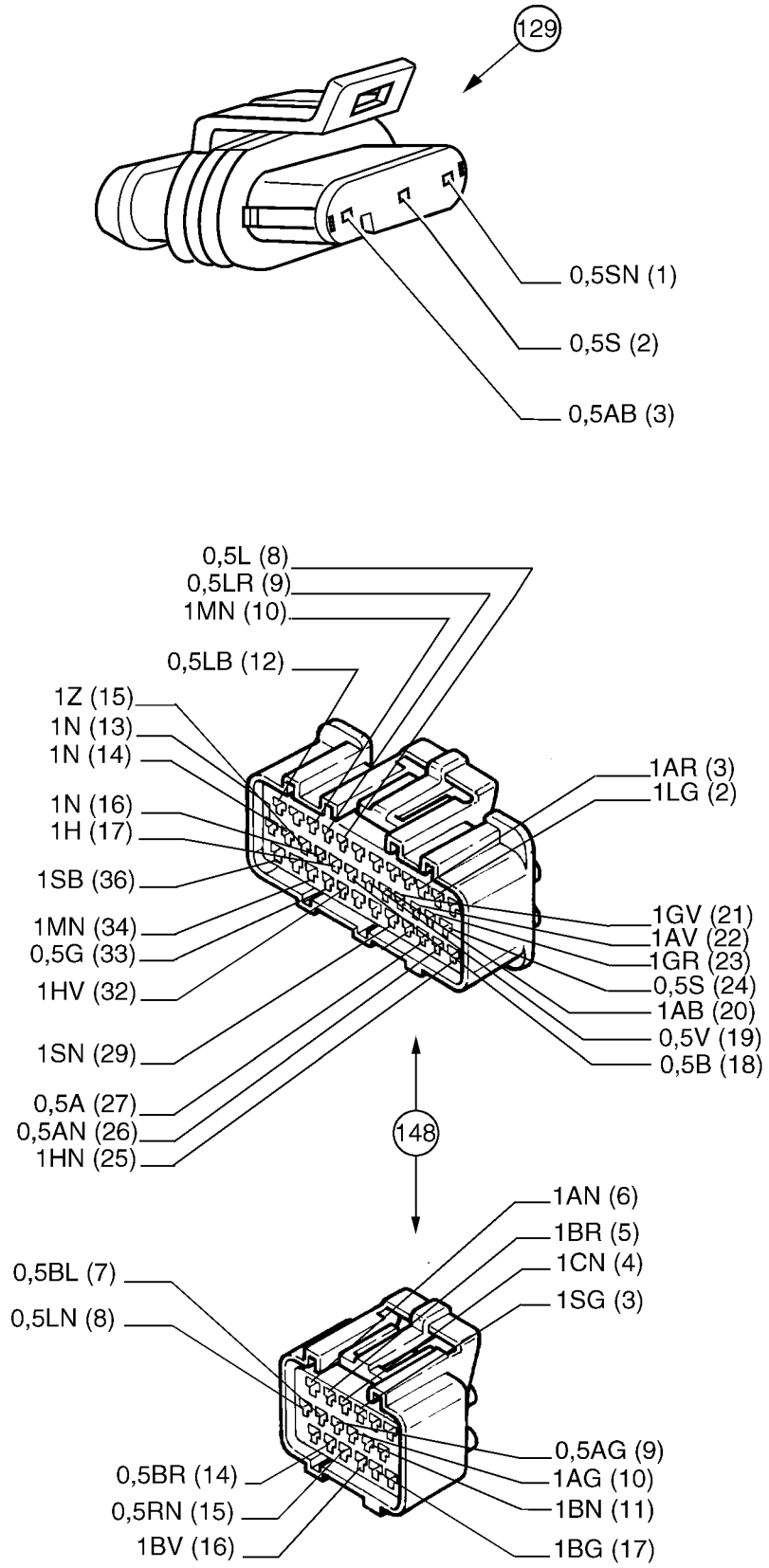
YES

Replace the ECU.

Check the wiring and eliminate the cause of the open circuit.



FAULT CODE 11



FAULT CODE 12

The wiring on potentiometer (1) on the clutch pedal is in short to +12V or the ground reference is interrupted, or the potentiometer is faulty.

The clutch pedal does not work and the HIGH and LOW lamps flash alternately.
The tractor can be moved by using the Power Shuttle lever.

Turn the starter key to the OFF position. Remove the left-hand panel under the dashboard. Is the potentiometer wiring (1) on the clutch pedal disconnected?

NO → Disconnect connection (129) and, using a digital tester, measure the resistance between terminals (1) and (2) on the potentiometer (with the pedal released). Is the reading ~ 3.5 kΩ?

NO → Replace the potentiometer.

YES → Connect the connection

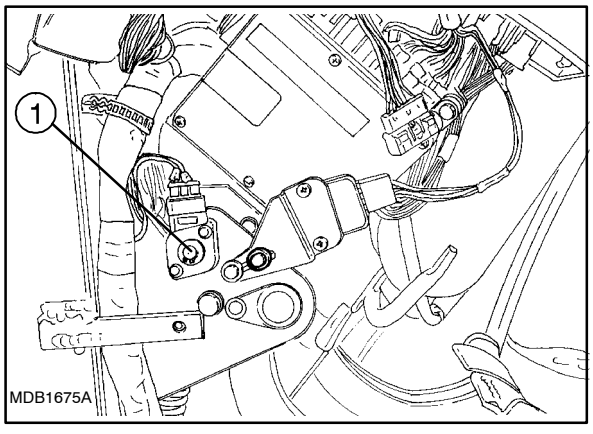
YES → Disconnect connections (148) on the (ECU).
Is there electrical continuity between pin CN2-29 (SN) on connections (148) and wire SN on the wiring on connection (129) of the potentiometer?

NO → Check the wiring and eliminate the cause of the open circuit.

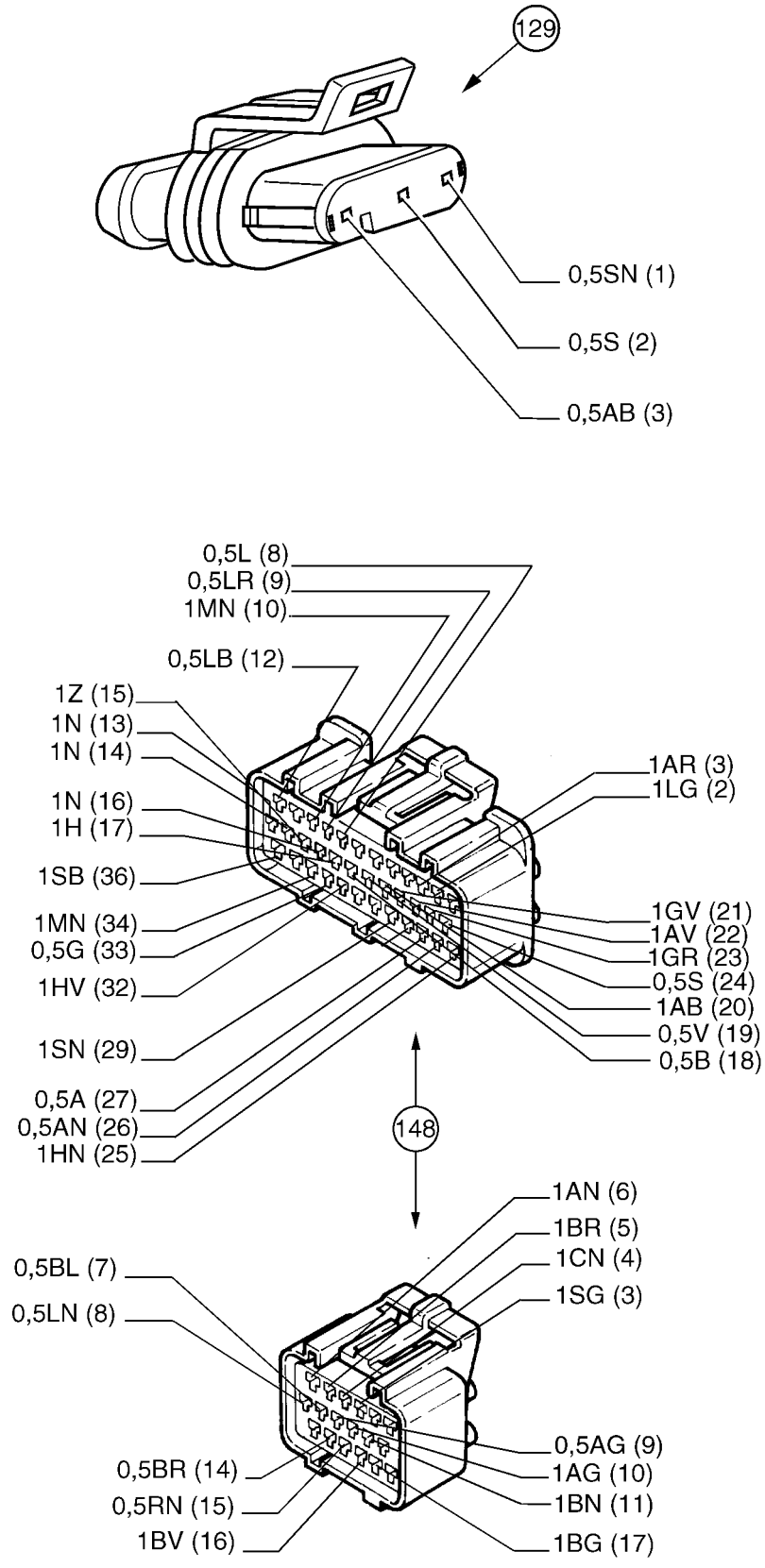
YES → Turn the starter key to the OFF position.
Is there a reading of +5V or +12V between CN2-24 (S) on connections (148) and ground?

NO → Replace the ECU.

YES → Check the wiring and eliminate the cause of the short to +5V or +12V.



FAULT CODE 12



FAULT CODE 13

The HIGH and LOW push-buttons are pressed at the same time following a fault on one of the two buttons, or the wiring is in short to +12V.

With this fault the HIGH and LOW speeds cannot be selected, but the transmission remains operative.

Turn the starter key to the OFF position.
Disassemble the HIGH and LOW push-button knobs.
Using a digital tester check the operation of the two push-buttons.
Is one of the two buttons in short?

NO

Remove the rear right-hand wheel.
Disconnect connection (19) on the HIGH and LOW push-buttons.
Are wires (AV) and (AR) in short circuit, or is one/both in short circuit with wire (MB)?

NO

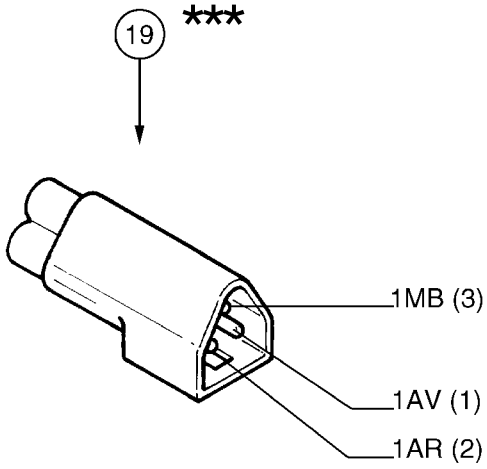
YES

Replace the faulty push-button.

YES

Check the wiring and eliminate the cause of the short circuit.

Replace the ECU.



FAULT CODE 14

The wiring on gear-neutral position sensor push-button (W) is in short circuit or the push-button is faulty.

A start request will be processed with the Power Shuttle lever but only if the speed sensor is problem-free, otherwise the transmission will be disabled.

Turn the starter key to the OFF position. Remove the rear right-hand wheel and disconnect connection (139) on the push-button. Position the gear lever in neutral and, using a digital tester, measure the electrical resistance on the ends of the push-button. Is the resistance ~ 550 Ω?

NO → Replace the push-button

YES

Are the two wires (LG) and (AB) (wiring side) in short circuit?

NO → Replace the ECU.

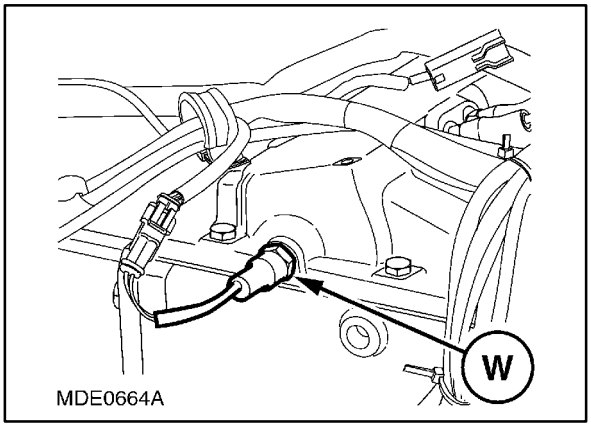
YES

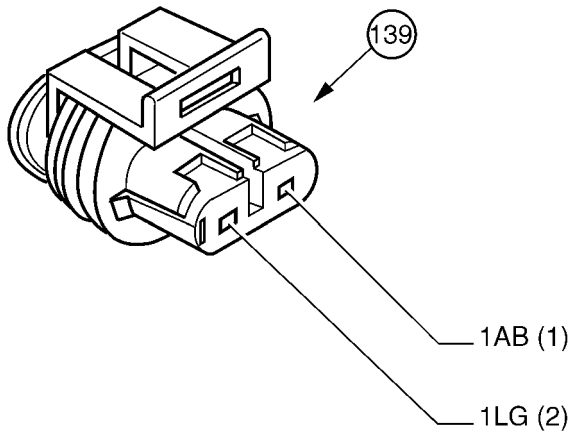
Disconnect connection (79) (48-way). Check the wiring between connection (139) and pins 34 and 26 on connection (79). Does the fault persist?

YES

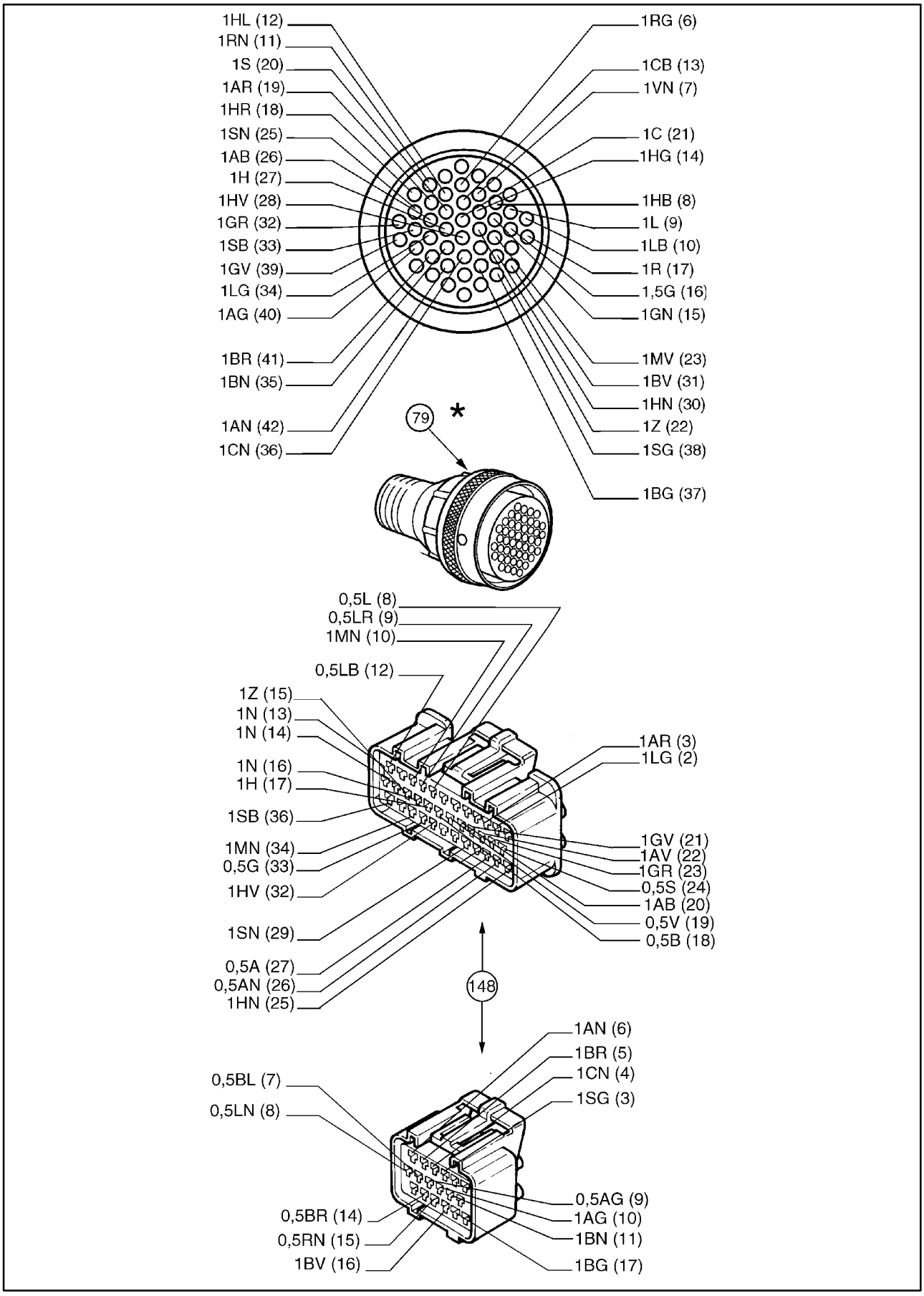
Disconnect connections (148) on the ECU. Check for a short circuit or open circuit between pin CN2-2 (LG) and CN2-20 (AB) on connections (148) with pins 34 (LG) and 26 (AB) on connection (79).
Is the fault no longer present?

NO → Replace the ECU.





FAULT CODE 14



FAULT CODE 15

The wiring on gear-neutral position sensor push-button (W) is in short circuit to ground, or disconnected, or the push-button is faulty.

A start request will be processed with the Power Shuttle lever but only if the speed sensor is problem-free, otherwise the transmission will be disabled.

Turn the starter key to the OFF position. Remove the rear right-hand wheel and check connection (139) on the push-button.
Are the relative wires connected?

NO → Connect the wires.

YES

Position the gear lever in neutral. Disconnect connection (139) and, using a digital tester, measure the electrical resistance on the ends of the push-button.
Is the resistance ~ 550 Ω?

NO → Replace the push-button if interrupted.

YES

Disconnect connection (79): Is wire (LG) (wiring side) in short circuit to ground or is there no electrical continuity with wire (LG) on connection (139)?

NO → Disconnect connections (148) on the ECU). Is pin CN2-2 (LG) on connections (148) in short circuit to ground, or is there no electrical continuity with pin 34 on connection (79)?

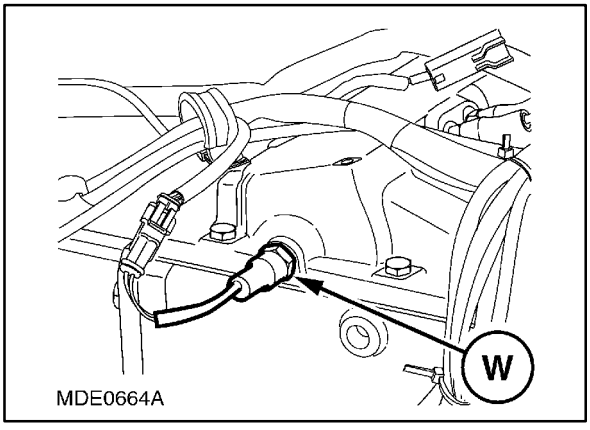
NO → Replace the ECU.

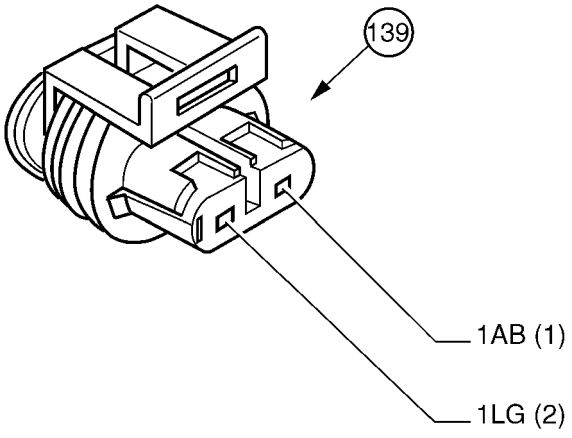
YES

Check the wiring and eliminate the cause of the short circuit to ground or open circuit.

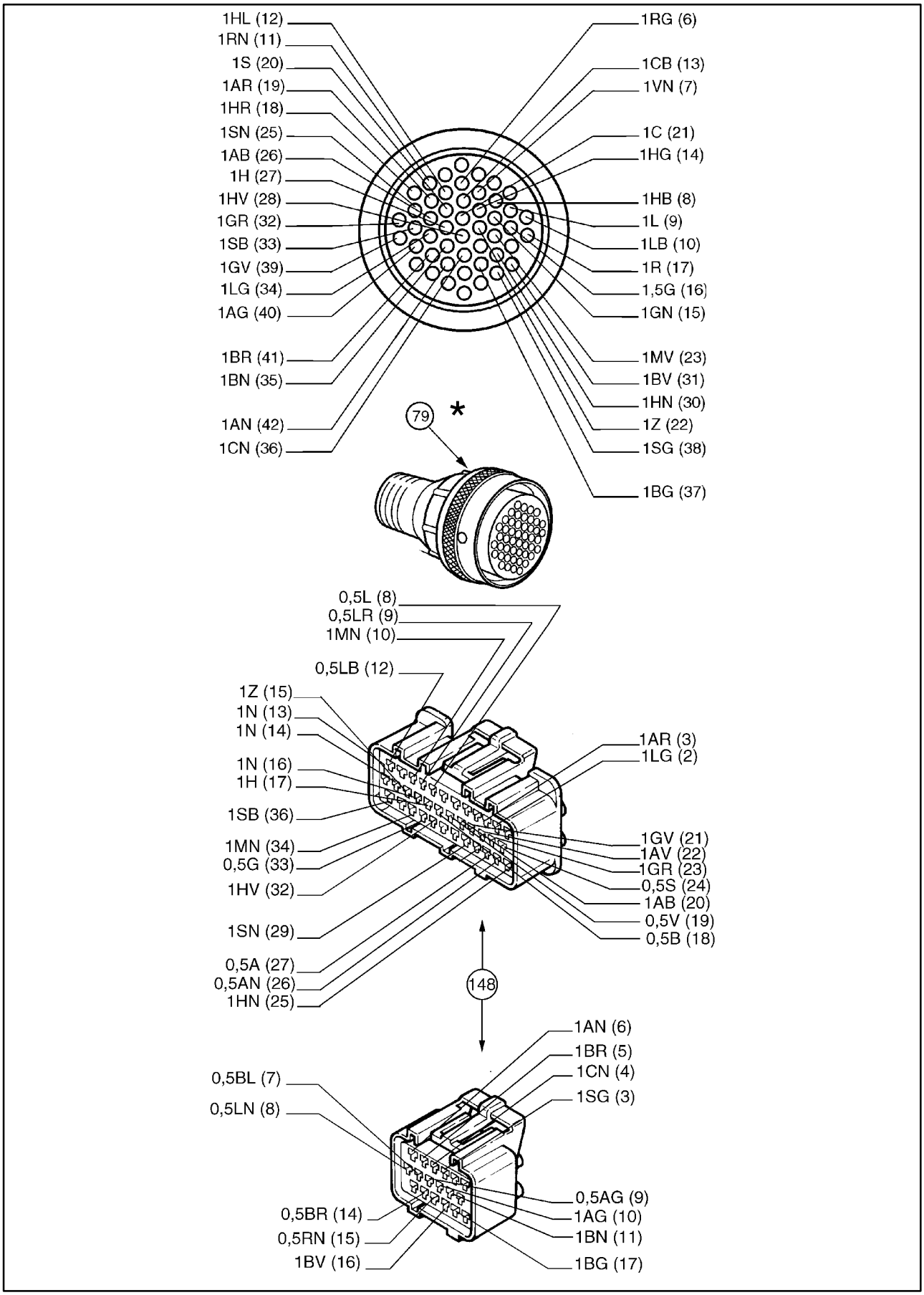
YES

Check the wiring and eliminate the cause of the short circuit to ground or open circuit.





FAULT CODE 15



FAULT CODE 16

The wiring on push-button (K) range position sensor (R1) is in short circuit or the push-button is faulty.

A start request will be processed with the Power Shuttle lever but only if the speed sensor is problem-free, otherwise the transmission will be disabled.

Turn the starter key to the OFF position. Move the window washer liquid tank and disconnect connection (140) on push-button (R1).
Position the gear lever in neutral and, using a digital tester, measure the electrical resistance on the ends of the push-button. Is the resistance ~ 550 Ω?

NO → Replace the push-button

YES

Are the two wires (GR) and (AB) (wiring side) in short circuit?

NO → Replace the ECU.

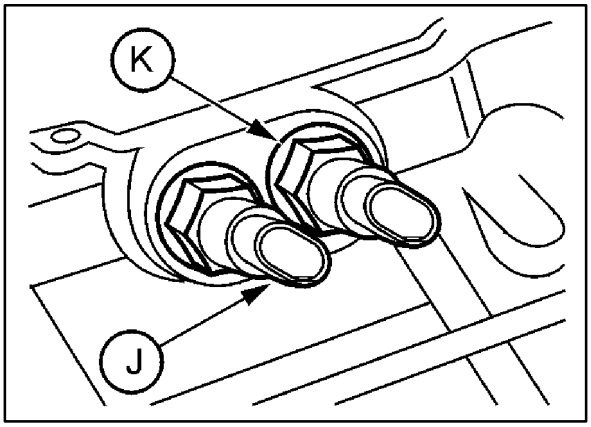
YES

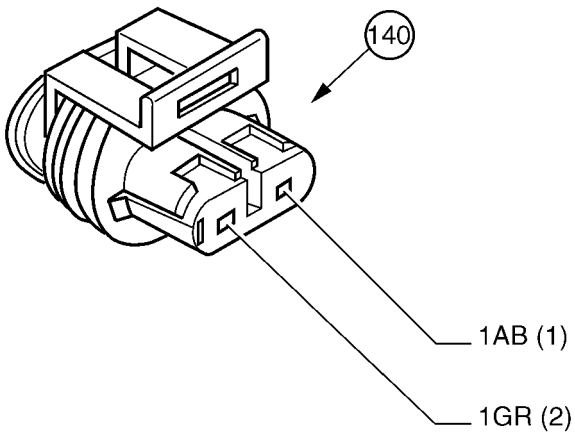
Disconnect connection (79) (48-way). Check the wiring between connection (140) and pins 32 and 26 on connection (79). Does the fault persist?

YES

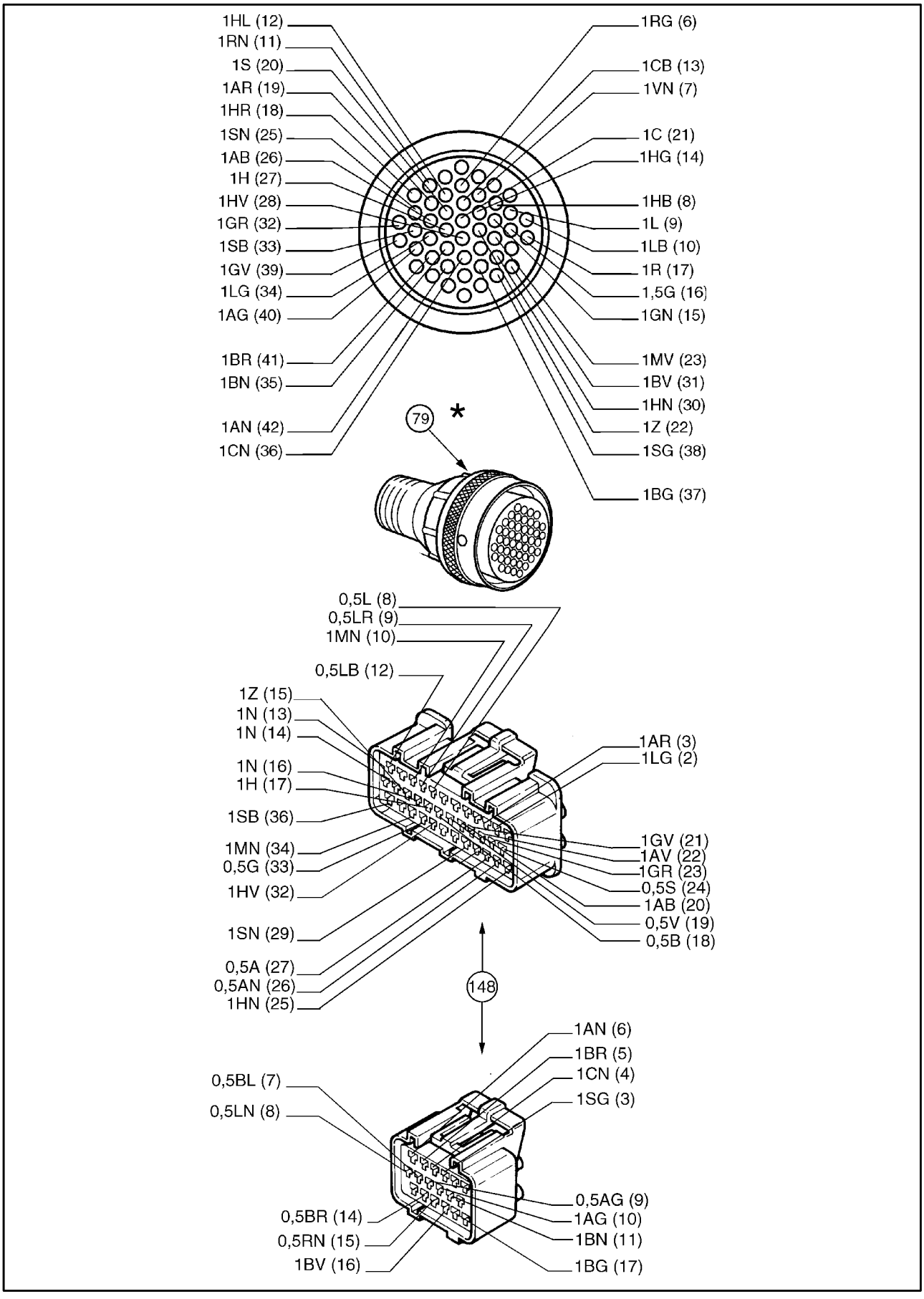
Disconnect connections (148) on the ECU). Check for a short circuit or open circuit between pin CN2-23 (GR) and CN2-20 (AB) on connections (148) with pins 32 (GR) and 26 (AB) on connection (79). Is the fault no longer present?

NO → Replace the ECU.





FAULT CODE 16



FAULT CODE 17

The wiring on push-button (K) range-neutral position sensor (R1) is in short circuit to ground, or disconnected, or the push-button is faulty.

A start request will be processed with the Power Shuttle lever but only if the speed sensor is problem-free, otherwise the transmission will be disabled.

Turn the starter key to the OFF position. Move the window washer liquid tank and check connection (140) on push-button (R1).
Are the relative wires connected?

NO → Connect the wires.

YES

Position the gear lever in neutral. Disconnect connection (140) and, using a digital tester, measure the electrical resistance on the ends of the push-button.
Is the resistance ~ 550 Ω?

NO → Replace the push-button if interrupted.

YES

Disconnect connection (79) (48-way). Is wire (GR) (wiring side) in short circuit to ground or is there no electrical continuity with wire (GR) on connection (140)?

NO → Disconnect connections (148) on the ECU. Is pin CN2-23 (GR) on connections (148) in short circuit to ground or is there no electrical continuity with pin 32 on connection (79)?

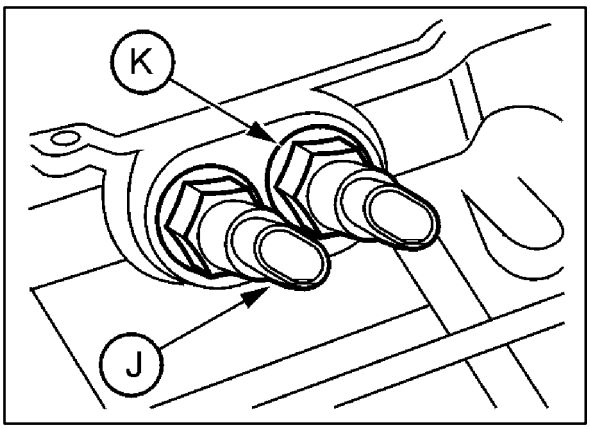
NO → Replace the ECU.

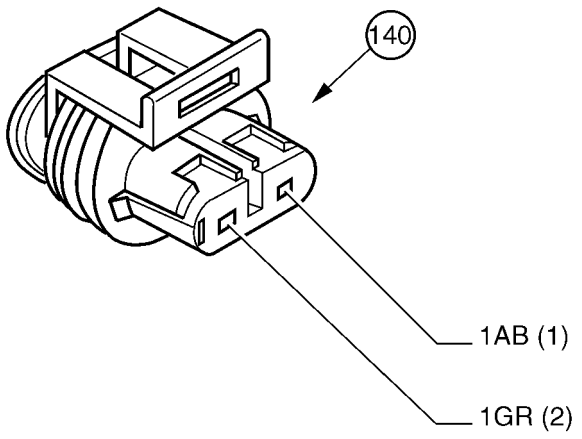
YES

Check the wiring and eliminate the cause of the short circuit to ground or open circuit.

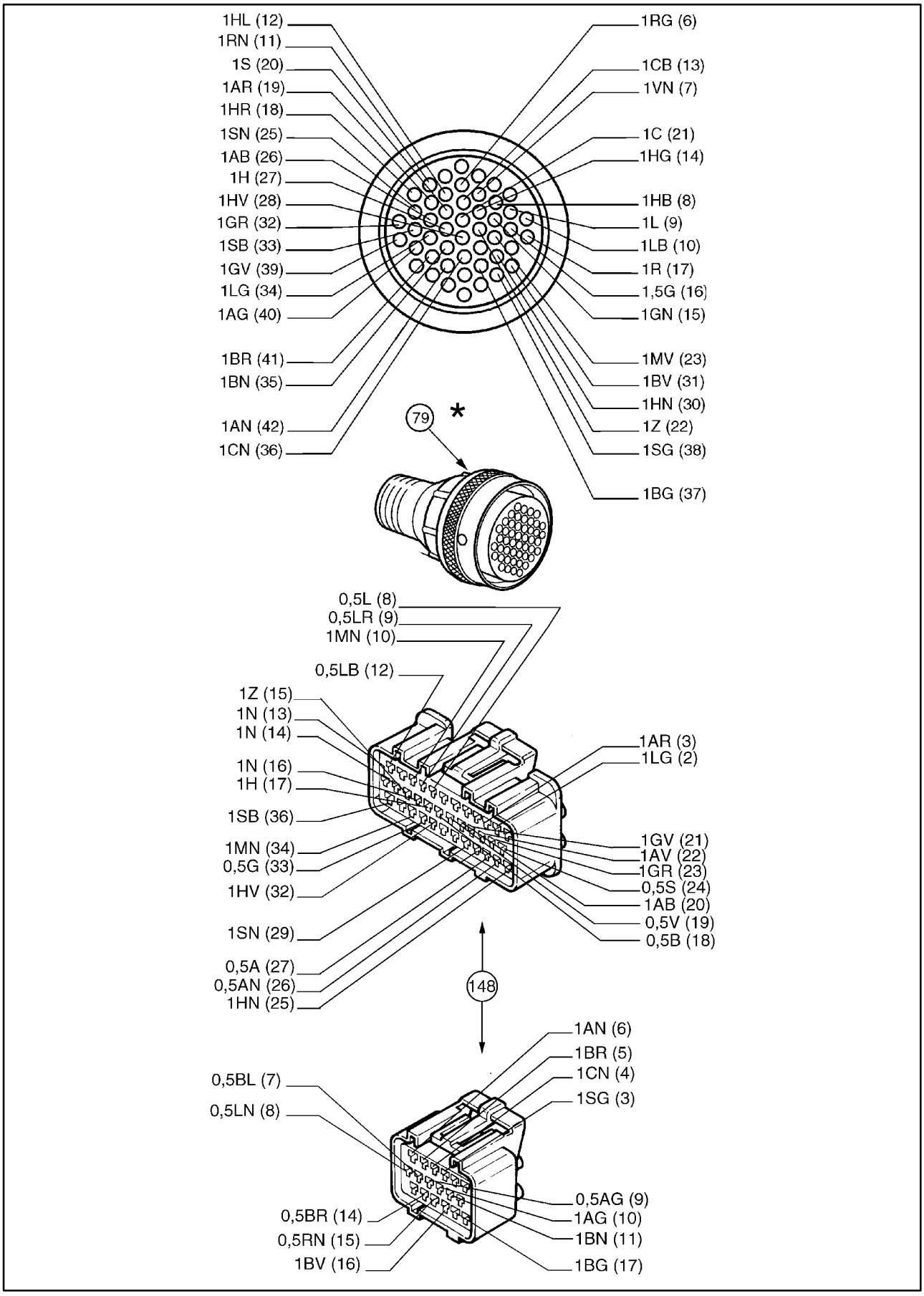
YES

Check the wiring and eliminate the cause of the short circuit to ground or open circuit.





FAULT CODE 17



FAULT CODE 18

The wiring on push-button (J) gear-neutral position sensor (R2) is in short circuit or the push-button is faulty.

A start request will be processed with the Power Shuttle lever but only if the speed sensor is problem-free, otherwise the transmission will be disabled.

Turn the starter key to the OFF position. Move the window washer liquid tank and disconnect connection (141) on push-button (R2).
Position the gear lever in neutral and, using a digital tester, measure the electrical resistance on the ends of the push-button. Is the resistance ~ 550 Ω?

NO → Replace the push-button

YES

Are the two wires (GV) and (AB) (wiring side) in short circuit?

NO → Replace the ECU.

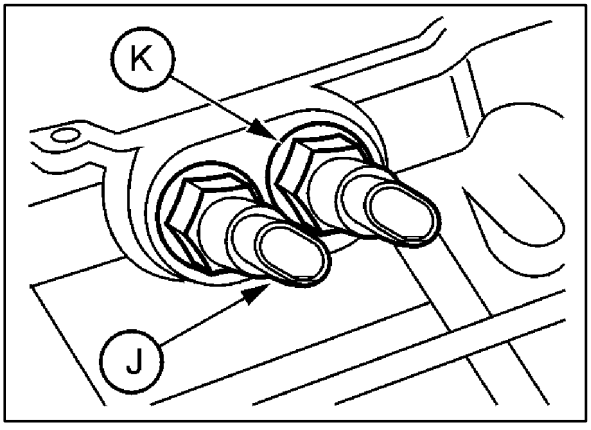
YES

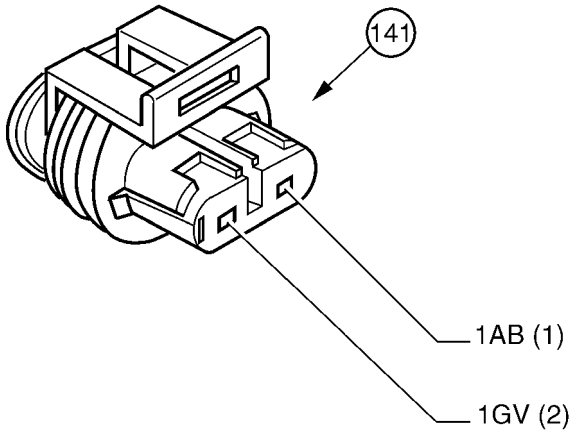
Disconnect connection (79) (48-way). Check the wiring between connection (141) and pins 39 and 26 on connection (79). Does the fault persist?

YES

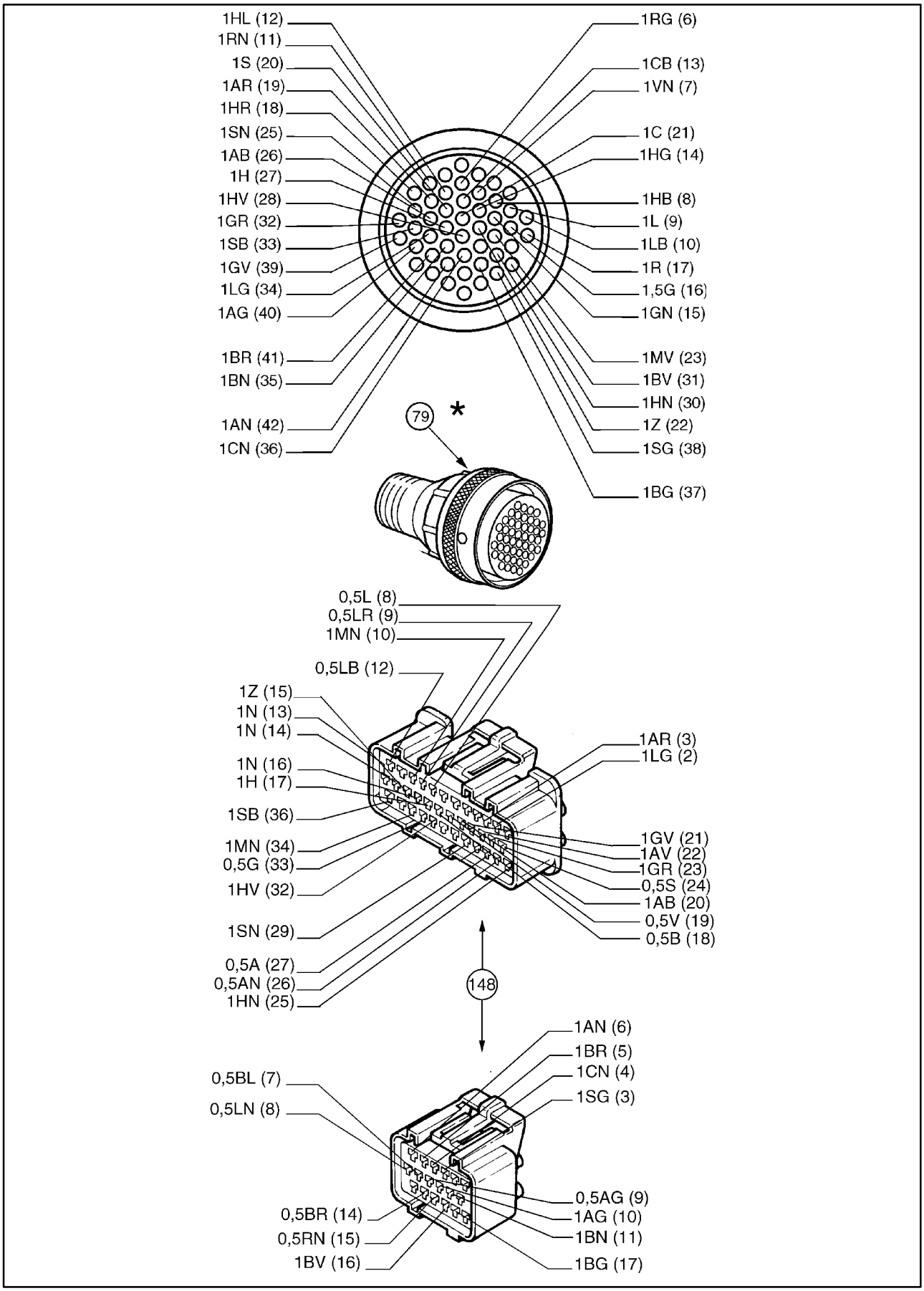
Disconnect connections (148) on the ECU. Check for a short circuit or open circuit between pin CN2-21 (GV) and CN2-20 (AB) on connections (148) with pins 39 (GV) and 26 (AB) on connection (79).
Is the fault no longer present?

NO → Replace the ECU.





FAULT CODE 18



FAULT CODE 19

The wiring on push-button (J) range-neutral position sensor (R2) is in short circuit to ground, or disconnected, or the push-button is faulty.

A start request will be processed with the Power Shuttle lever but only if the speed sensor is problem-free, otherwise the transmission will be disabled.

Turn the starter key to the OFF position. Move the window washer liquid tank and check connection (141) on push-button (R2).
Are the relative wires connected?

NO → Connect the wires.

YES

Position the gear lever in neutral. Disconnect connection (141) and, using a digital tester, measure the electrical resistance on the ends of the push-button.
Is the resistance ~ 550 Ω?

NO → Replace the push-button if interrupted.

YES

Disconnect connection (79): Is wire (GV) (wiring side) in short circuit to ground or is there no electrical continuity with wire (GV) on connection (141)?

NO → Disconnect connections (148) on the ECU. Is pin CN2-21 (GV) on connections (148) in short circuit to ground or is there no electrical continuity with pin 39 on connection (79)?

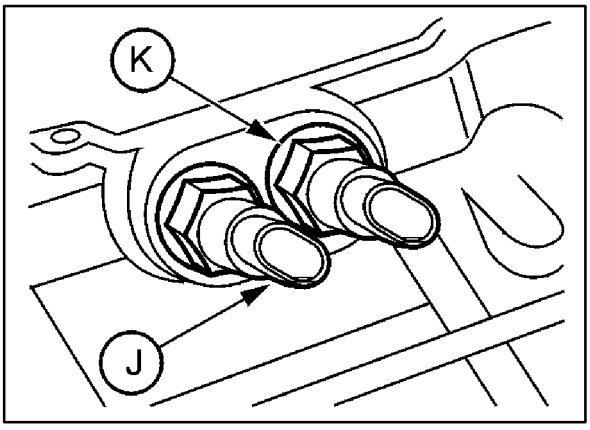
NO → Replace the ECU.

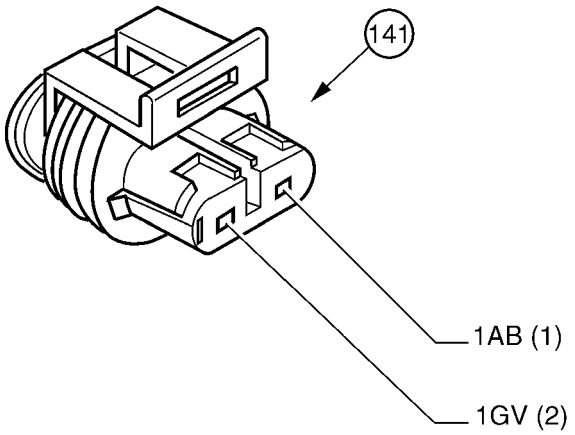
YES

Check the wiring and eliminate the cause of the short circuit to ground or open circuit.

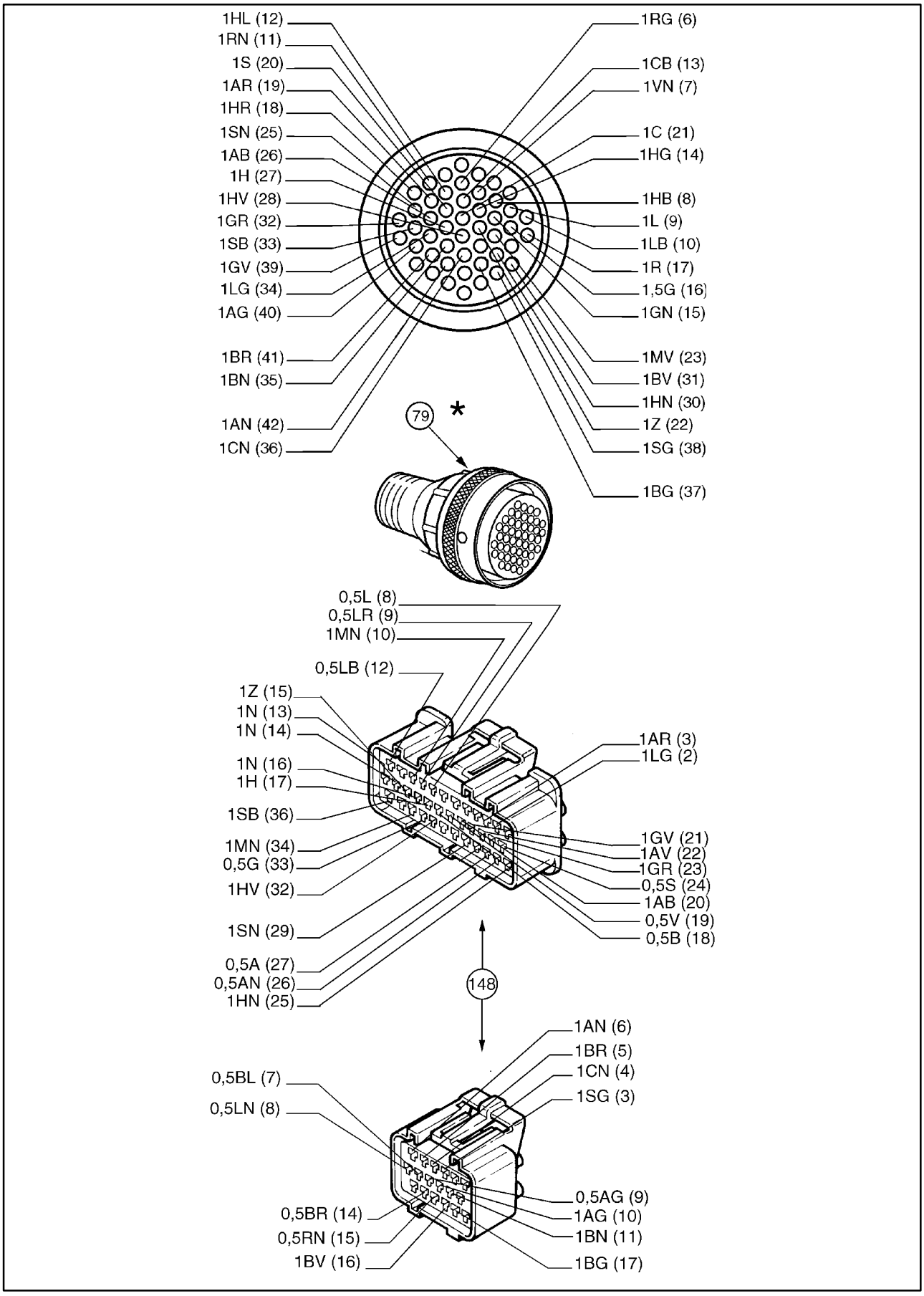
YES

Check the wiring and eliminate the cause of the short circuit to ground or open circuit.





FAULT CODE 19



FAULT CODE 22

The wiring on solenoid valve (13, page 10) of clutch (A) (forward gears) (3, page 8) is in short or the solenoid valve is faulty.

Forward gears are disabled.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel.
Disconnect connection (134) on the solenoid valve of clutch (A).
Is the electrical resistance on the solenoid valve coil, measured with a digital tester, ~ 10 Ω?

NO → Replace the solenoid valve coil if in short.

YES

Are the two wires (AG) and (AN) (wiring side) in short circuit?

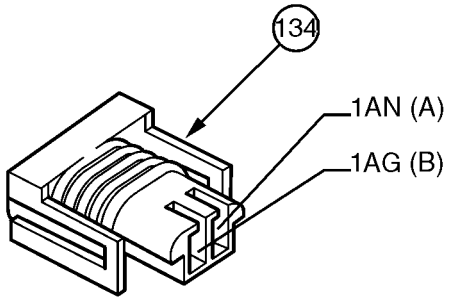
NO → Replace the ECU.

YES

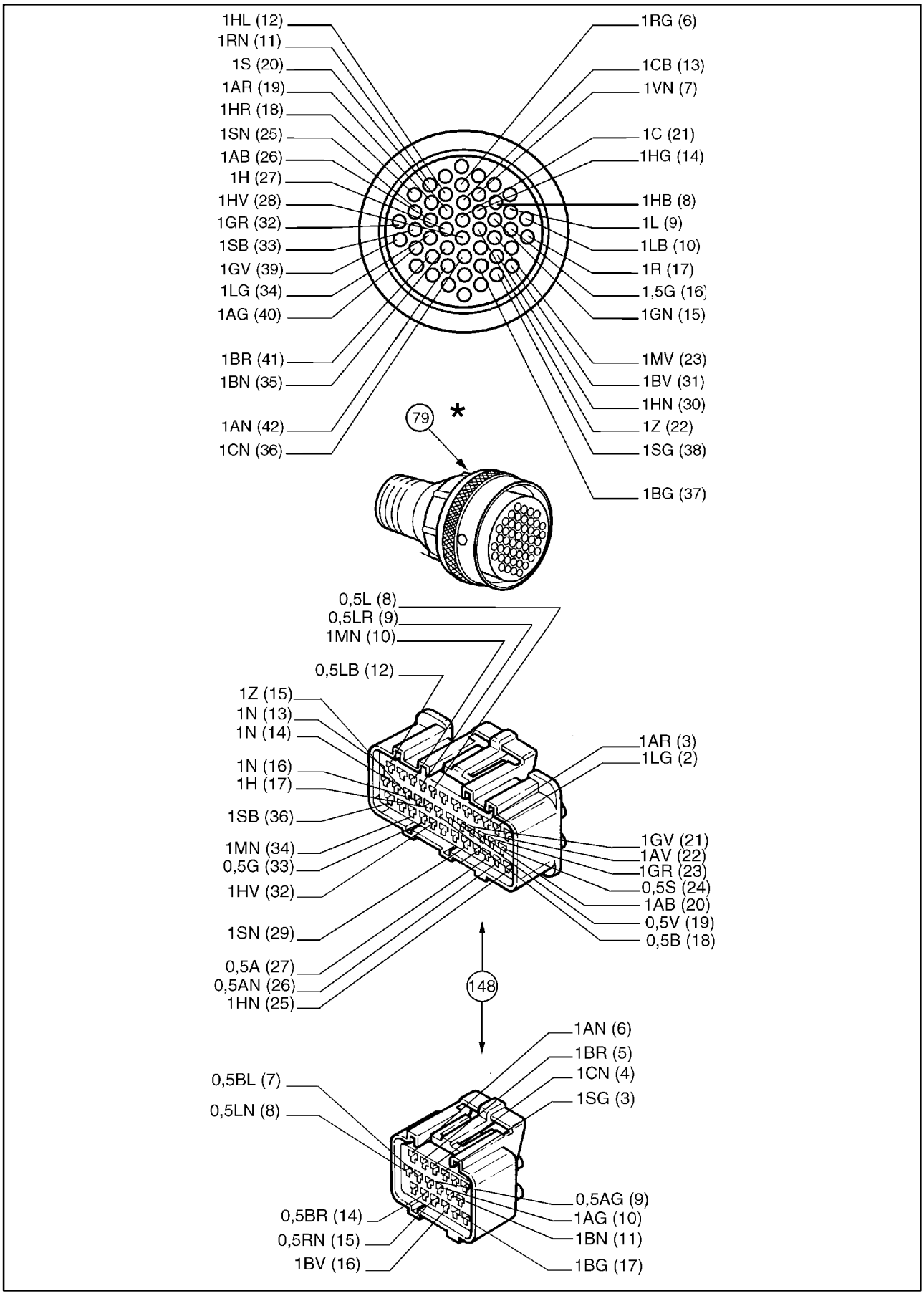
Check the wiring between connection (134) on the solenoid valve and pins 40 (AG) and 42 (AN) on connection (79). Eliminate the cause of the short circuit.
Does the fault persist?

YES

Disconnect connections (148) on the ECU. Check the wiring between pins CN1-10 (AG) and CN1-6 (AN) on connections (148) and pins 40 (AG) and 42 (AN) on connection (79).
Eliminate the cause of the short circuit.



FAULT CODE 22



FAULT CODE 23

The wiring on solenoid valve (12, page 10) of clutch (B) (reverse gears) (5, page 8) is in short or the solenoid valve is faulty.

The tractor can only be used in forward gear.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel.
Disconnect connection (135) on the solenoid valve of clutch (B).
Is the electrical resistance on the solenoid valve coil, measured with a digital tester, ~ 10 Ω?

NO → Replace the solenoid valve coil if in short.

YES

Are the two wires (BN) and (BR) (wiring side) in short circuit?

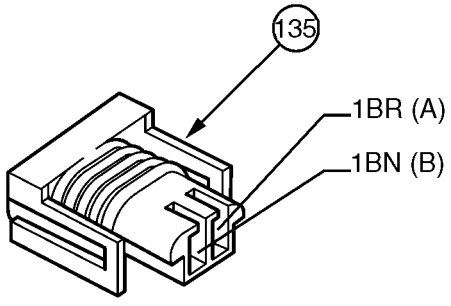
NO → Replace the ECU.

YES

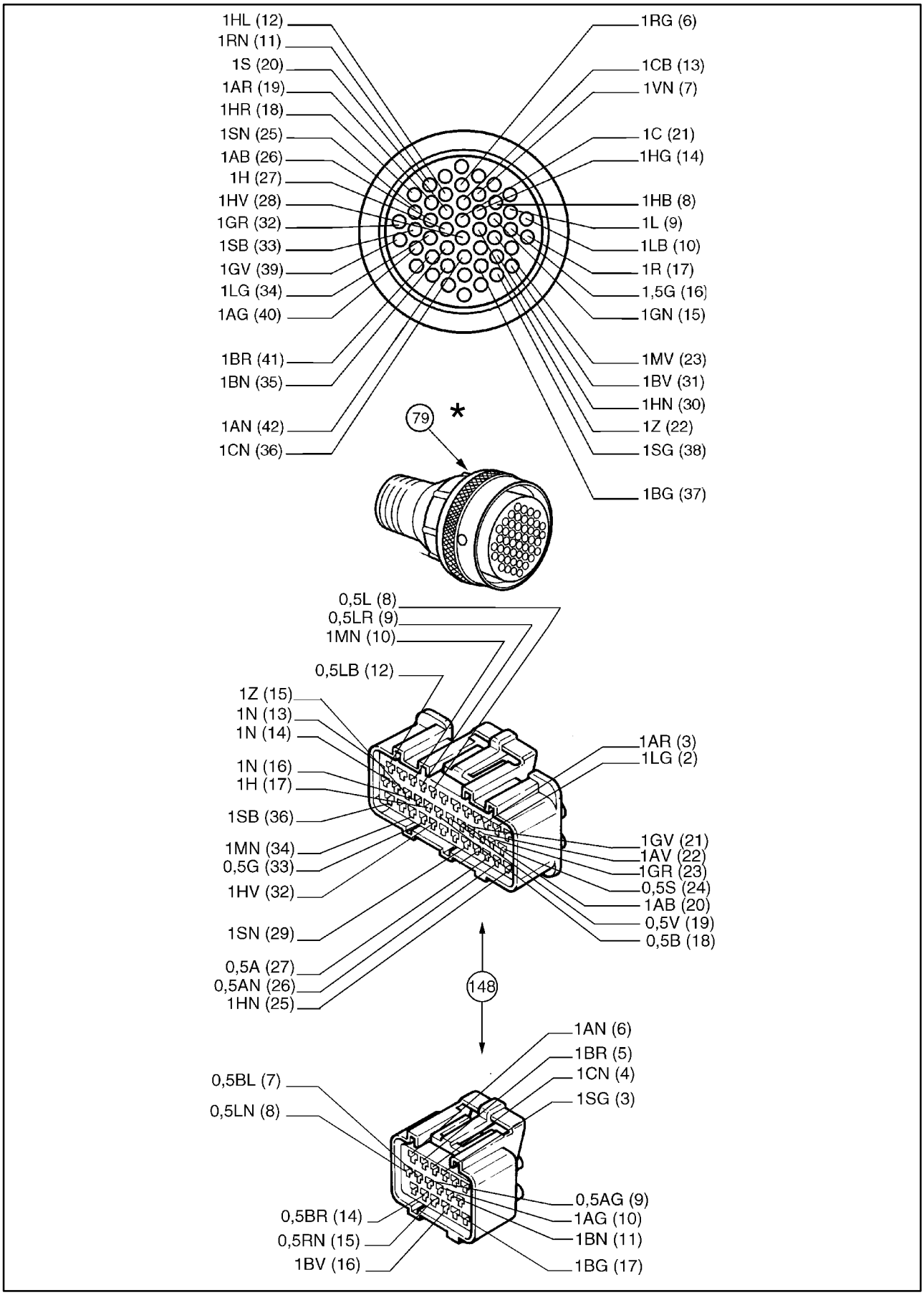
Check the wiring between connection (135) on the solenoid valve and pins 35 (BN) and 41 (BR) on connection (79).
Eliminate the cause of the short circuit.
Does the fault persist?

YES

Disconnect connections (148) on the ECU. Check the wiring between pins CN1-11 (BN) and CN1-5 (BR) on connections (148) with pins 35 (BN) and 41 (BR) on connection (79).
Eliminate the cause of the short circuit.



FAULT CODE 23

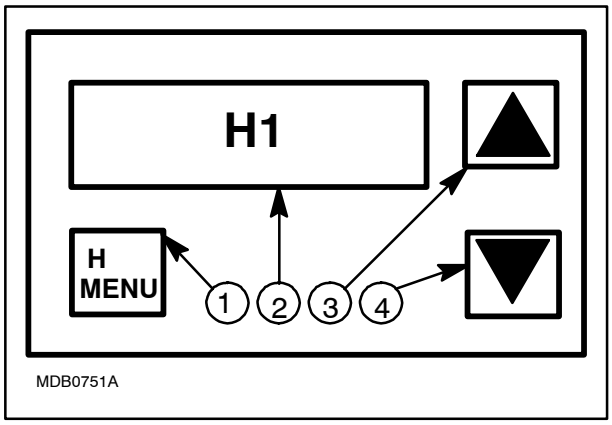


FAULT CODE 24

The clutches (A), (B), (C), (D) (3, 5, 7 and 8, page 8) have not been calibrated.

The tractor runs, but movement is abrupt.
The H1 MENU must be calibrated each time the ECU is replaced or after data has been cancelled from the memory (H8 MENU) on the ECU.

Carry out the calibration of clutches (A), (B), (C), (D), as described in the H1 MENU.



FAULT CODE 25

The frequency signal from the alternator socket (W) is too high for the engine speed.

It may not be possible to calibrate the hydraulic clutches.

Transmission hydraulic performance is not optimal.

Turn the starter key to the OFF position.
Is wire (Z) on alternator socket (W) correctly connected to the alternator?

NO → Connect the wire correctly.

YES

Is there electrical continuity between wire (Z) on the socket (W) and pin G on the front side connection (50)?

NO → Connect the wire correctly.

YES

Is there electrical continuity between pin G on connection (50) and pin CN2–15 (Z) on connections (148)?

NO → Connect the wire correctly.

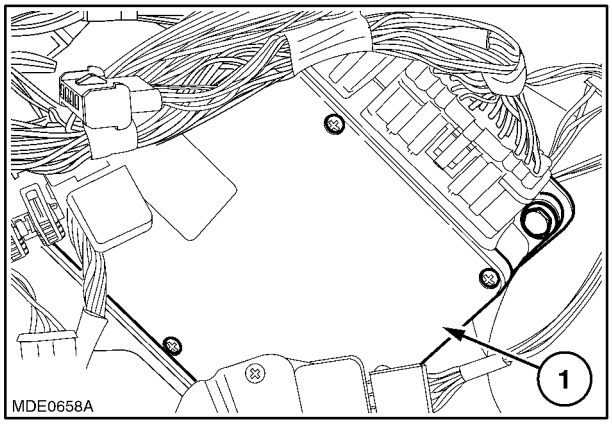
YES

Start the engine and accelerate to 1000 rpm (make sure that the recharging lamp is off).
Using a digital tester measure the frequency at the alternator output between the socket (W) and ground.
Is the frequency ~ 170 Hz?

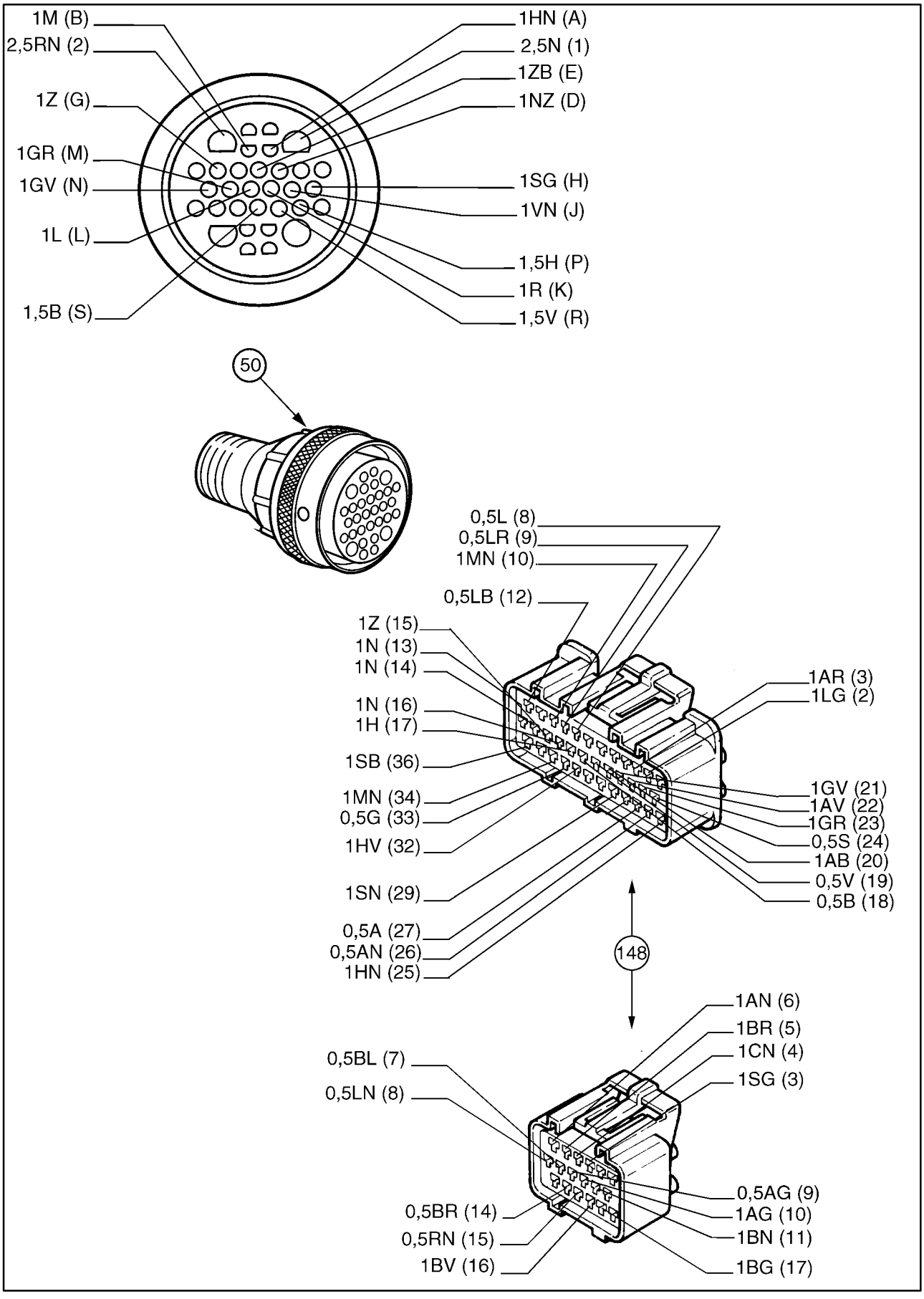
NO → Replace the alternator if the frequency value is much higher.

YES

Replace the ECU (1).

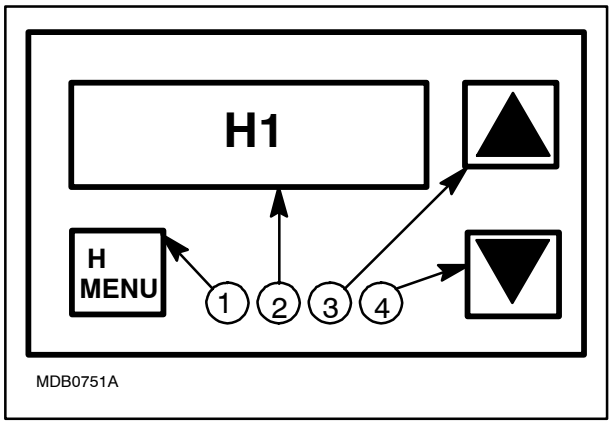


FAULT CODE 25



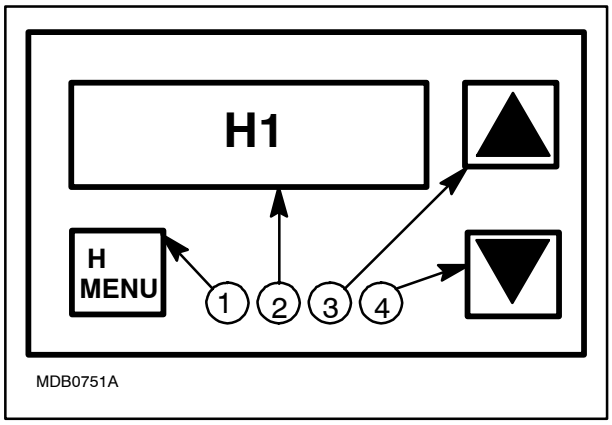
FAULT CODE 26

The hydraulic clutch (D) (8, page 8) on the LOW speed control has not been calibrated.
Tractor operation in Dual Command (2 Speed Power Shift) selection may be abrupt.
Using tool **294084** access the H1 MENU and calibrate the hydraulic clutches.



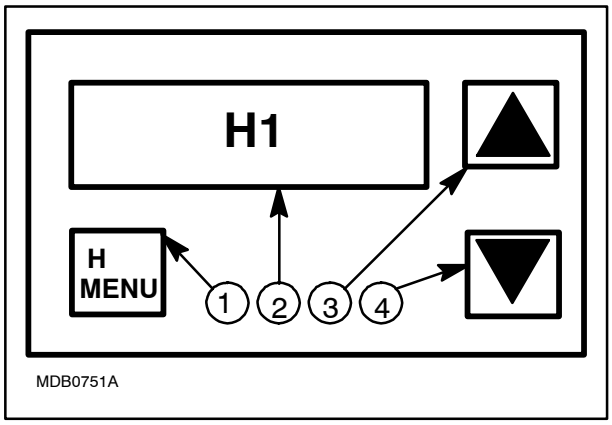
FAULT CODE 27

The hydraulic clutch (C) (7, page 8) on the HIGH speed control has not been calibrated.
Tractor operation in Dual Command (2 Speed Power Shift) selection may be abrupt.
Using tool **294084** access the H1 MENU and calibrate the hydraulic clutches.



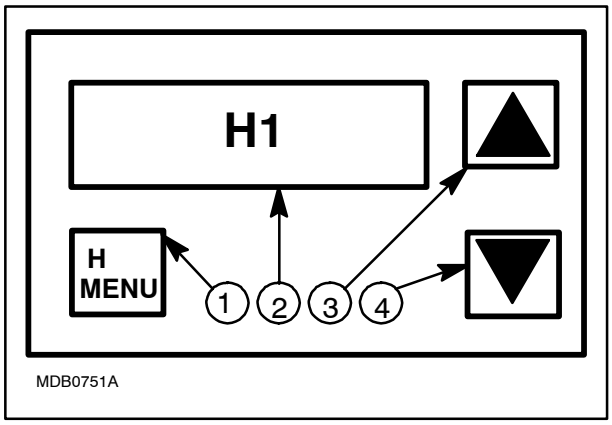
FAULT CODE 28

The hydraulic clutch (B) (5, page 8) on the reverse gear control has not been calibrated.
Tractor operation in reverse gear may be abrupt.
Using tool **294084** access the H1 MENU and calibrate the hydraulic clutches.



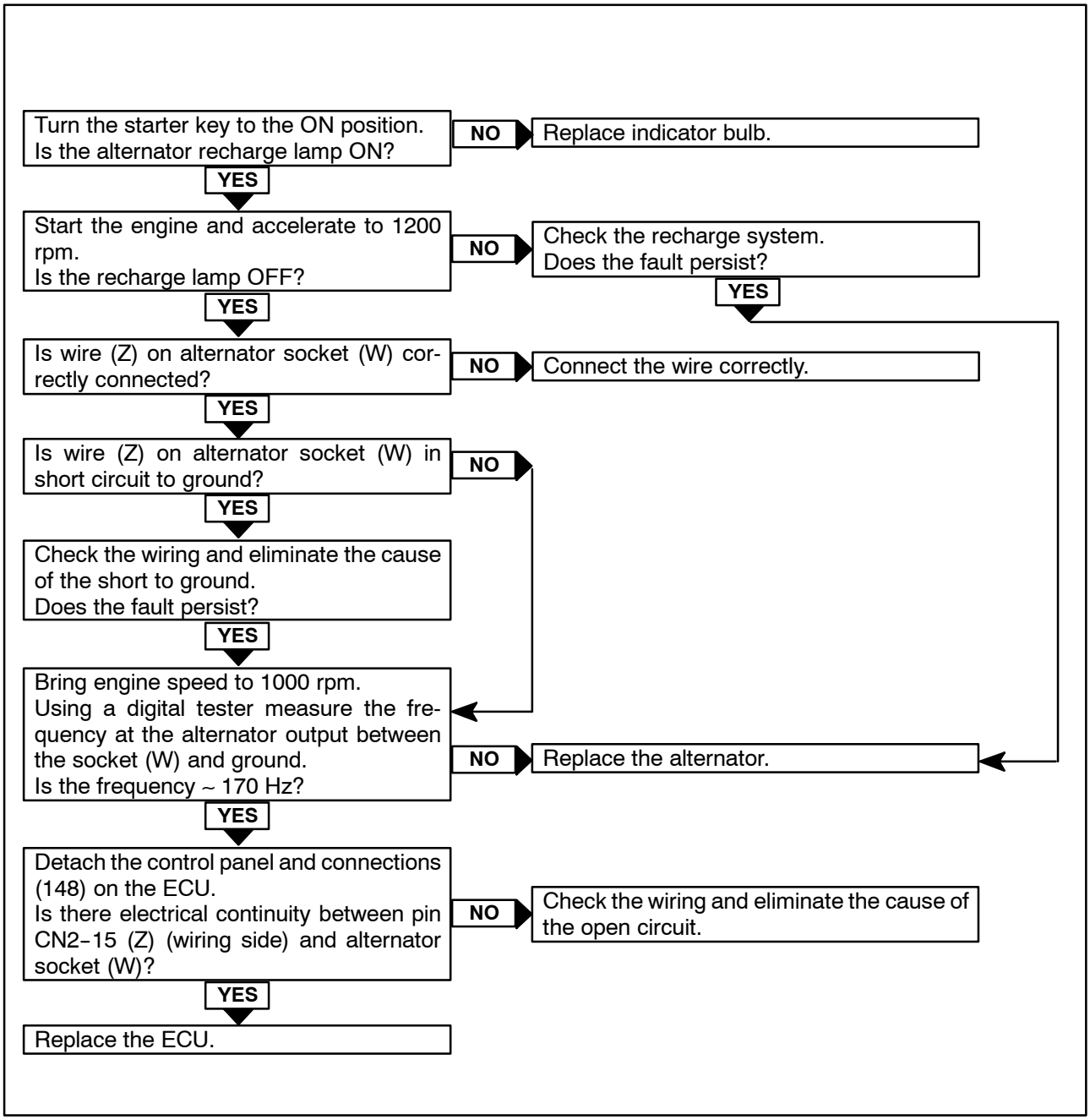
FAULT CODE 29

The hydraulic clutch (A) (3, page 8) on the forward gear control has not been calibrated.
Tractor operation in forward gear may be abrupt.
Using tool **294084** access the H1 MENU and calibrate the hydraulic clutches.

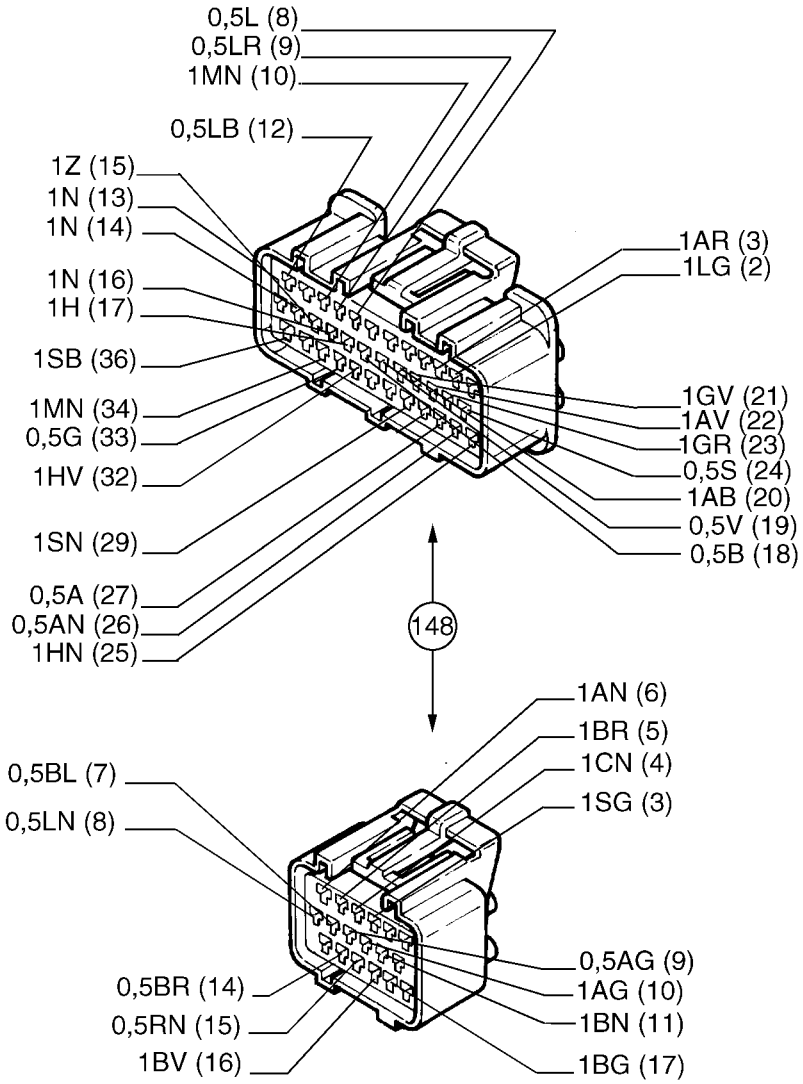


FAULT CODE 27

The frequency signal from the alternator socket (W), engine speed, is not read by the ECU.
Hydraulic clutch calibration cannot be carried out.
Transmission hydraulic performance is not optimal.



FAULT CODE 27



FAULT CODE 31

The wiring on solenoid valve (11, page 10) of clutch (C) (7, page 10) is in short or the solenoid valve is faulty.
The tractor can be used, but HIGH and LOW cannot be engaged.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel and the solenoid valve unit guard.
Disconnect connection (136) on solenoid valve C.
Is the electrical resistance of the solenoid valve coil, measured with a digital tester, ~ 7 Ω?

NO → Replace the solenoid valve coil if in short.

YES

Are the two wires (BV) and (CN) (wiring side) in short circuit?

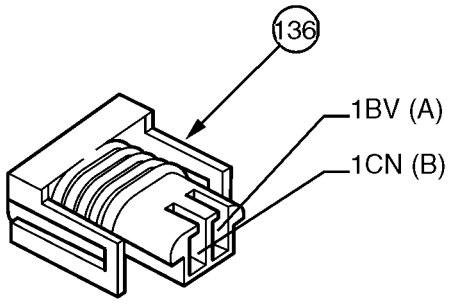
NO → Replace the ECU.

YES

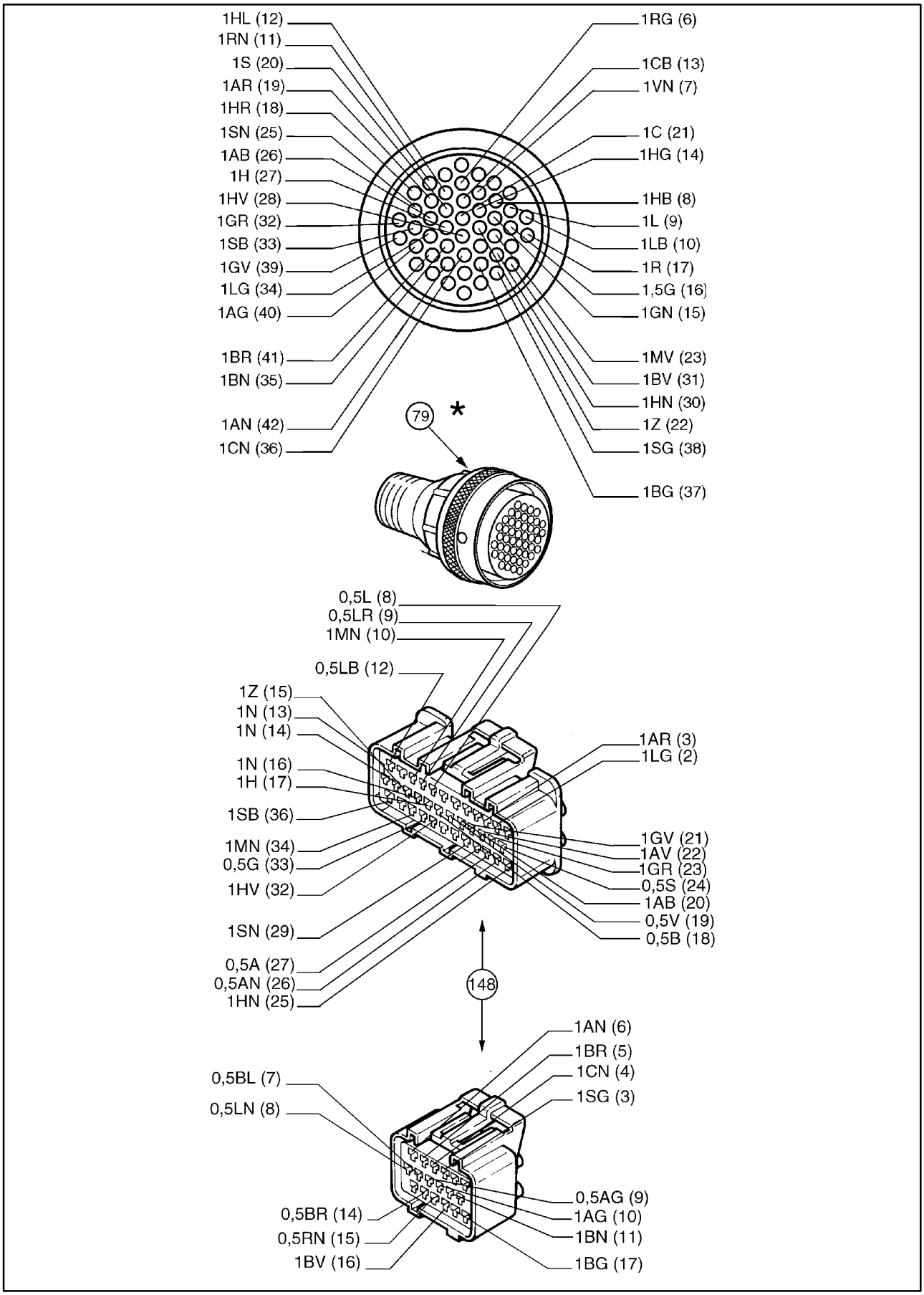
Check the wiring between connection (136) on the solenoid valve and pins 31 (BV) and 36 (CN) on connection (79). Eliminate the cause of the short circuit.
Does the fault persist?

YES

Disconnect connections (148) on the ECU. Check the wiring between pins CN1-16 (BV) and CN1-4 (CN) on connections (148) with pins 31 and 36 on connection (79).
Eliminate the cause of the short circuit.



FAULT CODE 31



FAULT CODE 32

The wiring on solenoid valve (10, page 10) of clutch (D) (8, page 8) is in short or the solenoid valve is faulty.
The tractor can be used, but HIGH and LOW cannot be engaged.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel and the solenoid valve unit guard.
Disconnect connection (137) on solenoid valve D.
Is the electrical resistance of the solenoid valve coil, measured with a digital tester, ~ 7 Ω?

NO → Replace the solenoid valve coil if in short.

YES

Are the two wires (BG) and (SG) (wiring side) in short circuit?

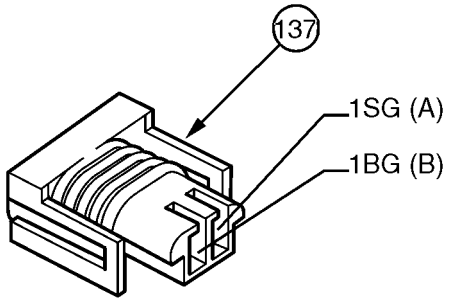
NO → Replace the ECU.

YES

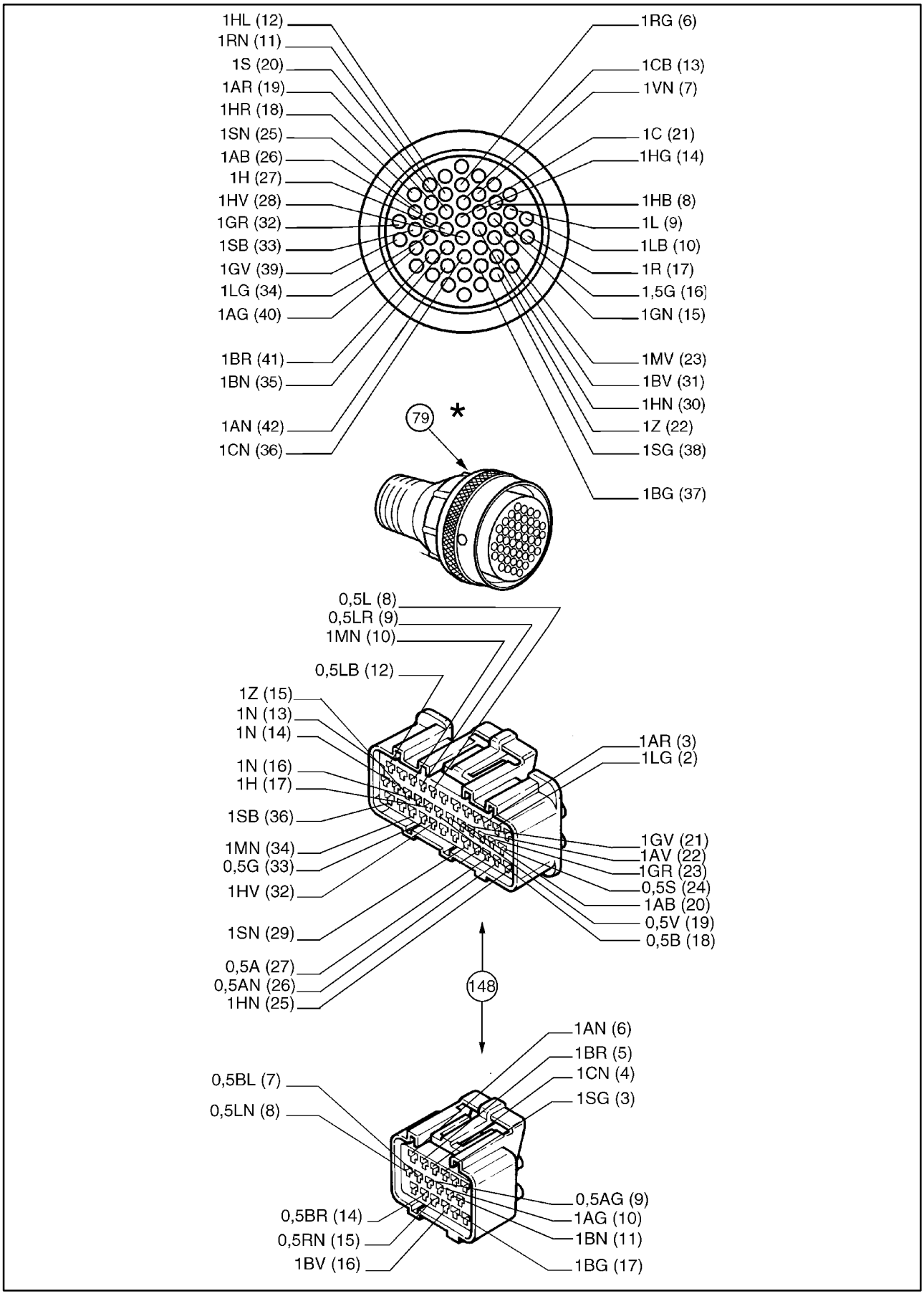
Check the wiring between connection (137) on the solenoid valve and pins 37 (BG) and 38 (SG) on connection (79). Eliminate the cause of the short circuit.
Does the fault persist?

YES

Disconnect connections (148) on the ECU. Check the wiring between pins CN1-17 (BG) and CN1-3 (SG) on connections (148) with pins 37 and 38 on connection (79).
Eliminate the cause of the short circuit.



FAULT CODE 32



FAULT CODE 33

The pressure on solenoid valve (13, page 10) of clutch (A) (forward gears) does not drop below 3 bars after a change from forward to reverse gear selection.

The transmission cannot be used.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel and the solenoid valve unit guard.
Remove solenoid valve A and check operation and rod movement. In any event, try replacing the solenoid valve. Does the problem persist?

NO → Replace the solenoid valve coil if in short.

YES

Check the safety pressure switch (132). Does it work correctly?

NO → Replace the pressure switch.

YES

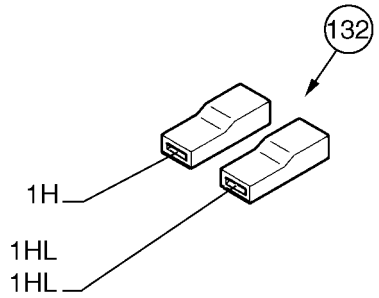
Check the wiring between connection (132), wires H and HL on the pressure switch, and connection (79) pin 27 (H) and 12 (HL). Correct any faults. Does the problem persist?

YES

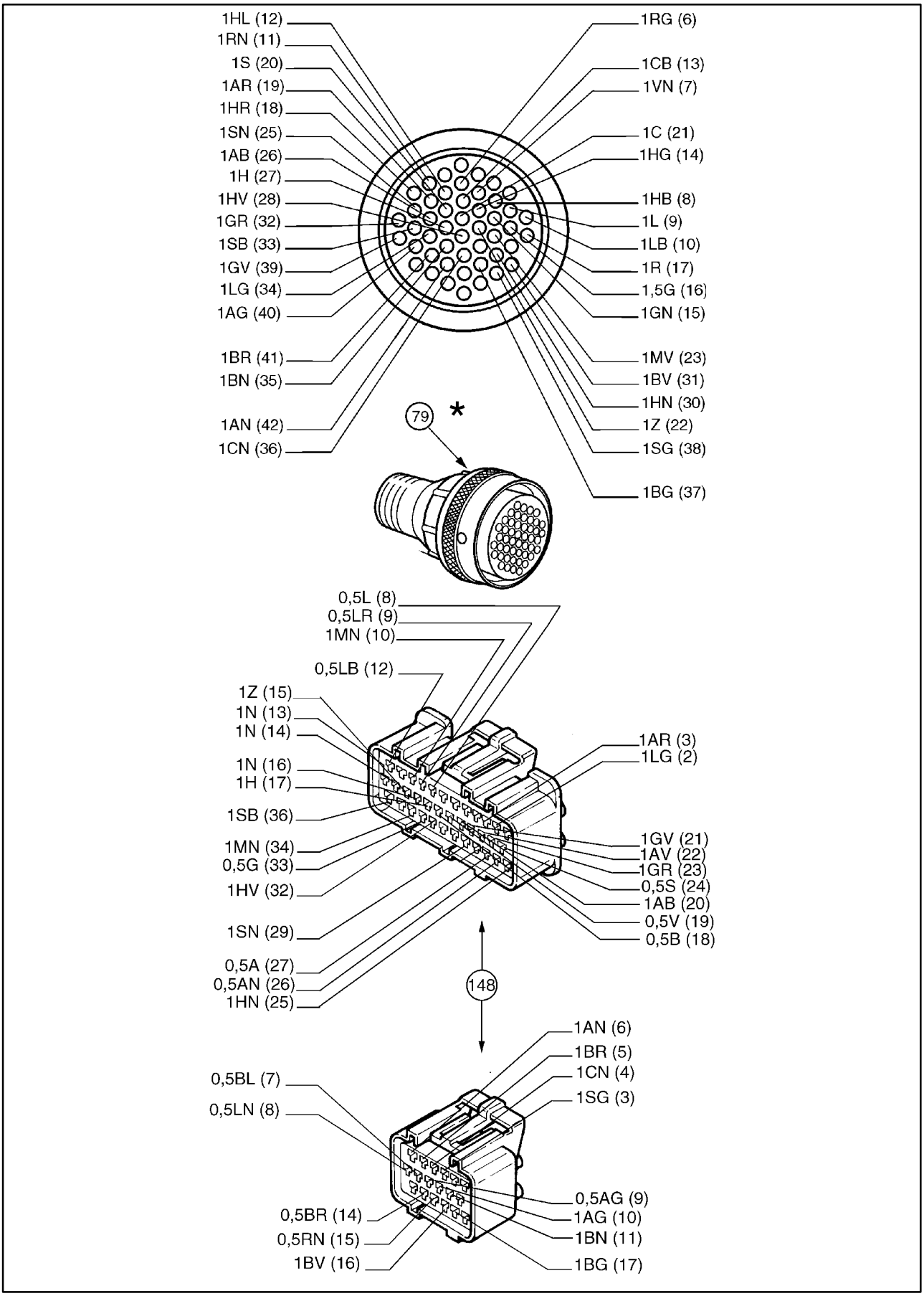
Check the wiring between connection (79) pin 27 (H) and connection (148) CN2-17. Correct any faults. Does the problem persist?

YES

Replace the ECU.



FAULT CODE 33



FAULT CODE 34

The wiring on tractor speed sensor (Y) is disconnected or in short circuit to +12V (power supply).
The tractor runs but may function irregularly.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel. The sensor is positioned on the transmission drive. Are connection (142) and the sensor wiring connected?
- NO → Connect the connection and/or wiring.
- YES ↓

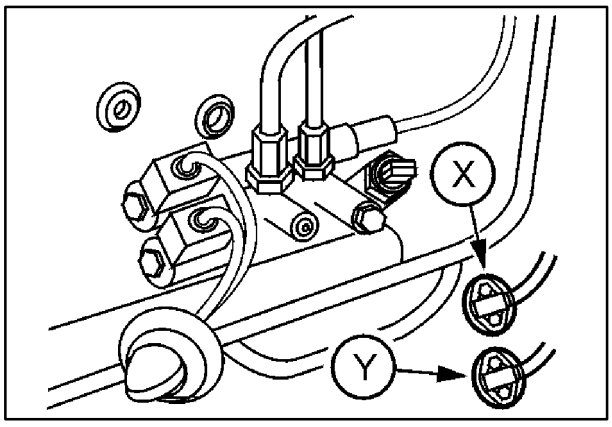
Disconnect connection (142) on the sensor.
Using a digital tester, measure the sensor electrical resistance.
Is the resistance ~ 700 Ω?
- NO → Replace the sensor if interrupted.
- YES ↓

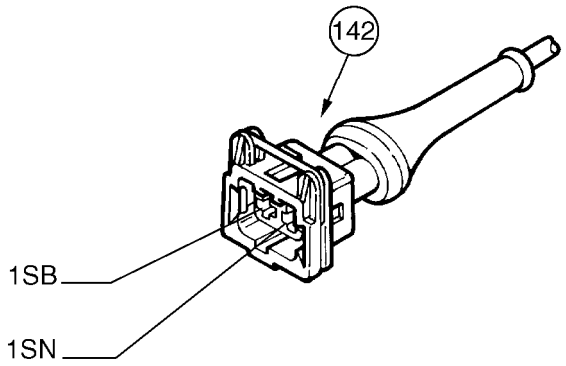
Is there electrical continuity between wire (SB) on connection (142) (SB) of the sensor and pin (33) (SB) on connection (79)?
- NO → Check the wiring and eliminate the cause of the open circuit.
- YES ↓

Is there electrical continuity between pin 33 on connection (79) (SB) of the sensor and pin CN2-36 (SB) on connection (148)?
- NO → Check the wiring and eliminate the cause of the open circuit.
- YES ↓

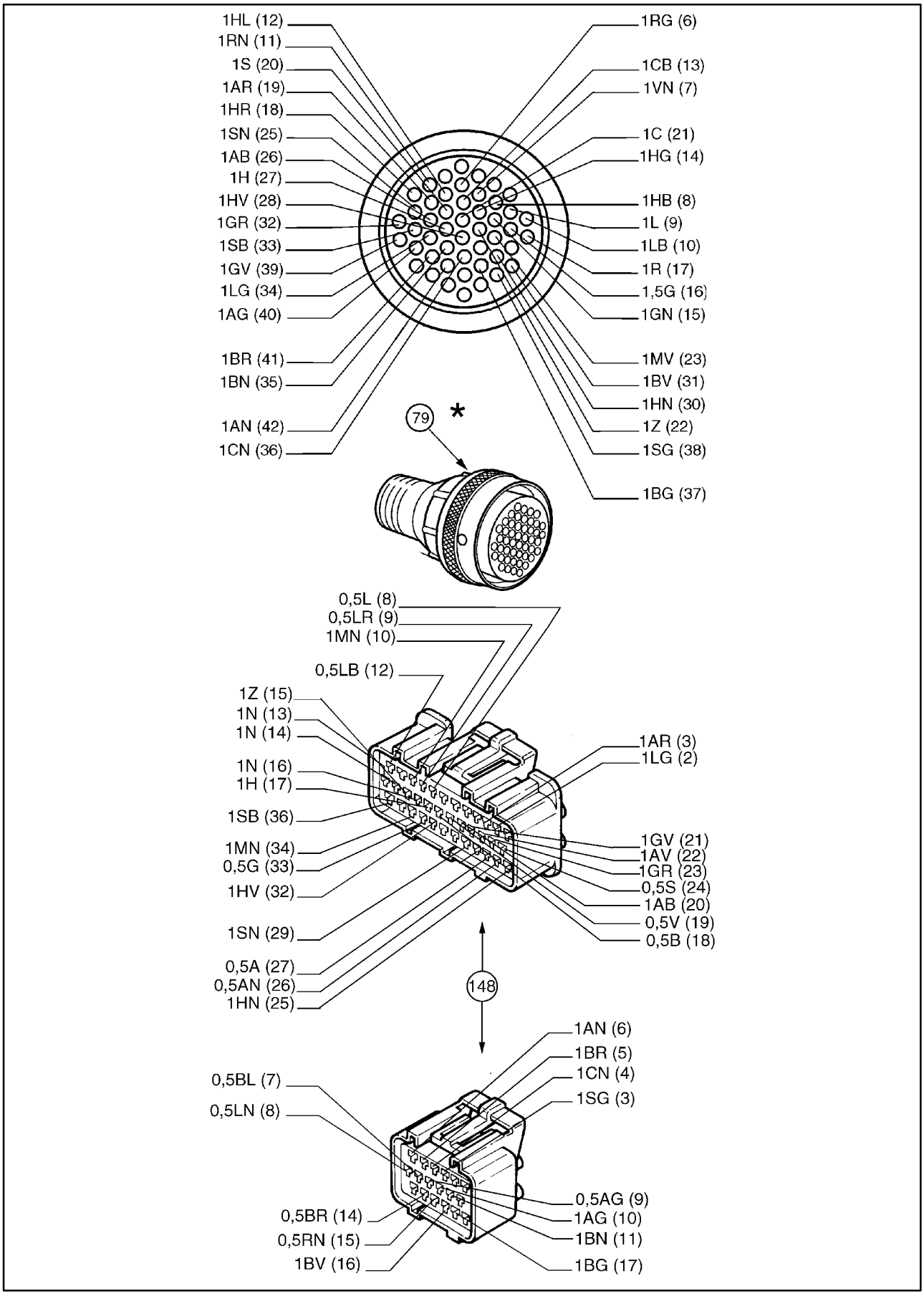
Turn the starter key to the ON position.
Between pin CN2-29 (SN) (wiring side) on connections (148) and ground, is the reading +12V?
- NO → Replace the ECU.
- YES ↓

Check the wiring and eliminate the cause of the short to +12V.





FAULT CODE 34



FAULT CODE 35

The wiring on tractor speed sensor (Y) is in short circuit to ground.

The tractor runs but may function irregularly.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel. The sensor is positioned on the transmission drive. Are connection (142) and the sensor wiring connected?

NO → Connect the wiring correctly.

YES

Disconnect connection (142) on the sensor.
Using a digital tester, measure the sensor electrical resistance.
Is the resistance ~ 700 Ω?

NO → Replace the sensor if faulty.

YES

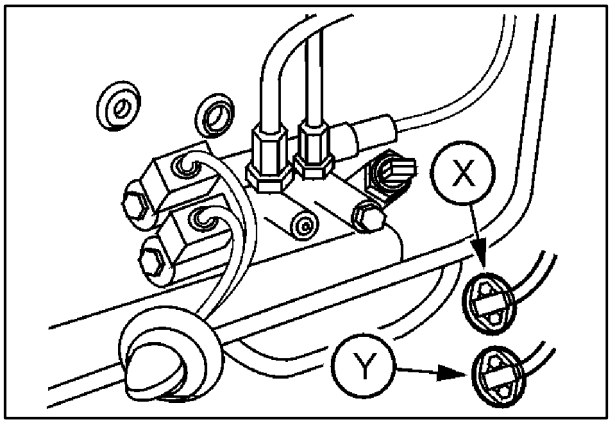
Check and eliminate any short circuits to ground on the wiring to pin SB on connection (142) on pin 33 (SB) on connection (79). Does the fault persist?

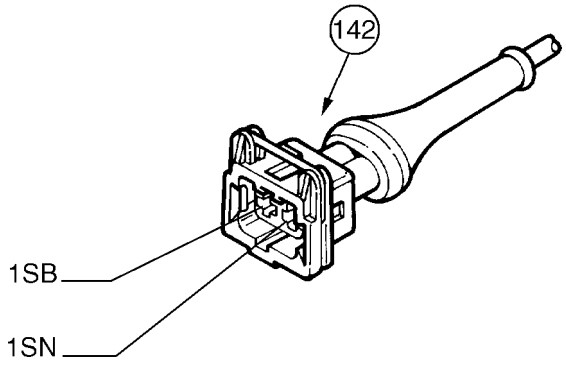
YES

Check and eliminate any short circuits to ground on the wiring to pin 33 (SB) on connection (79) on pin CN2-36 on connections (148). Does the fault persist?

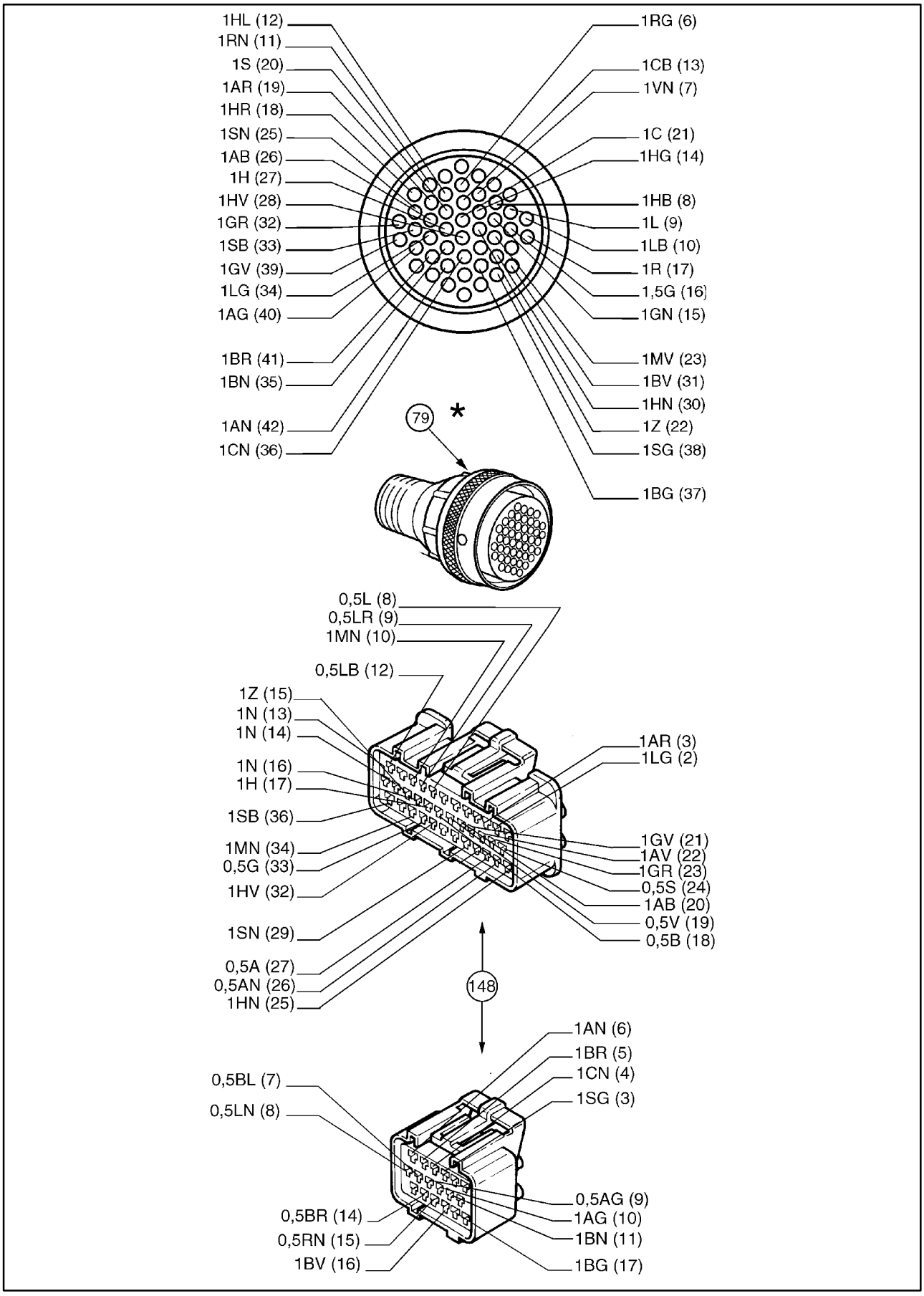
YES

Replace the ECU.



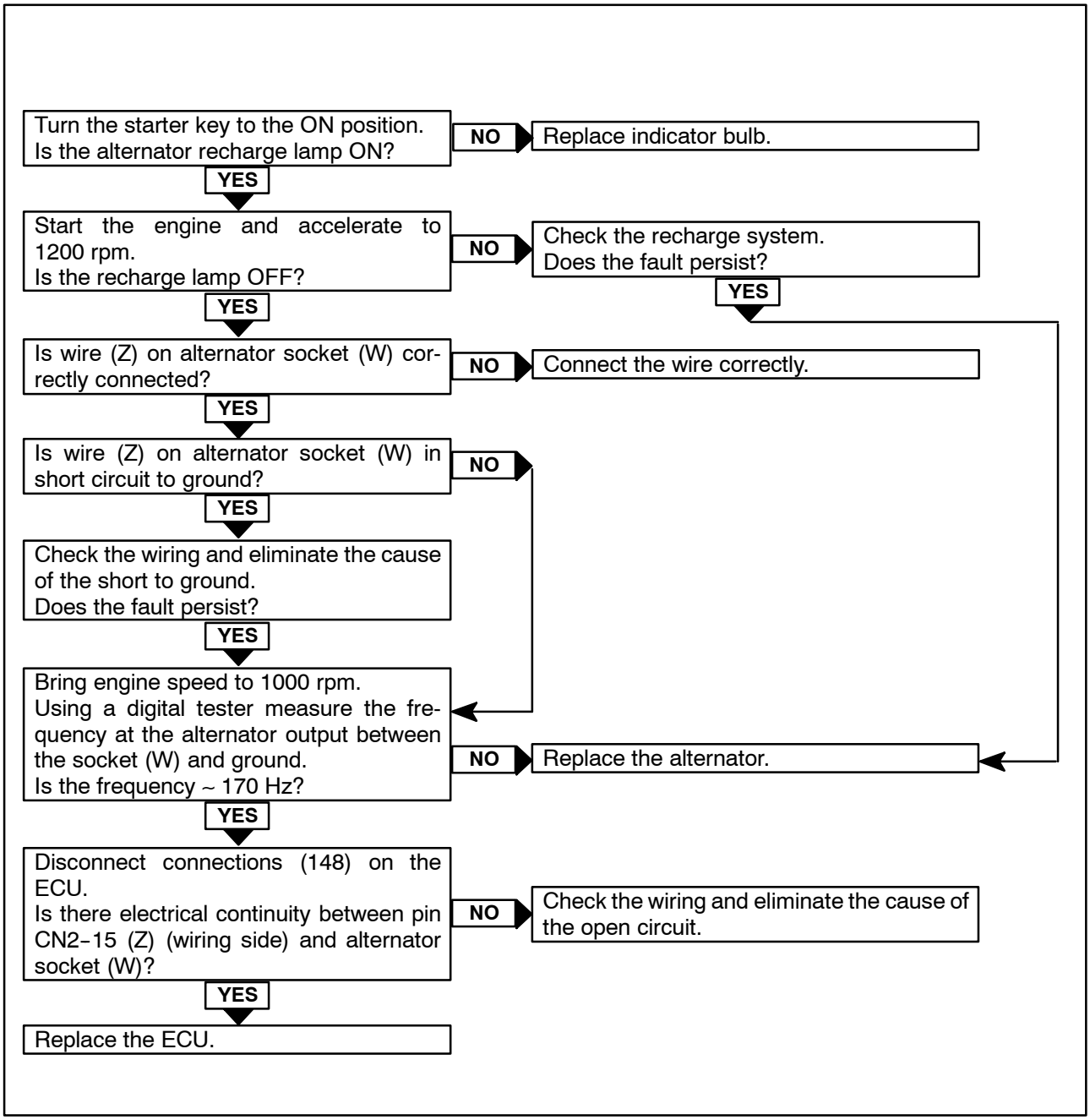


FAULT CODE 35

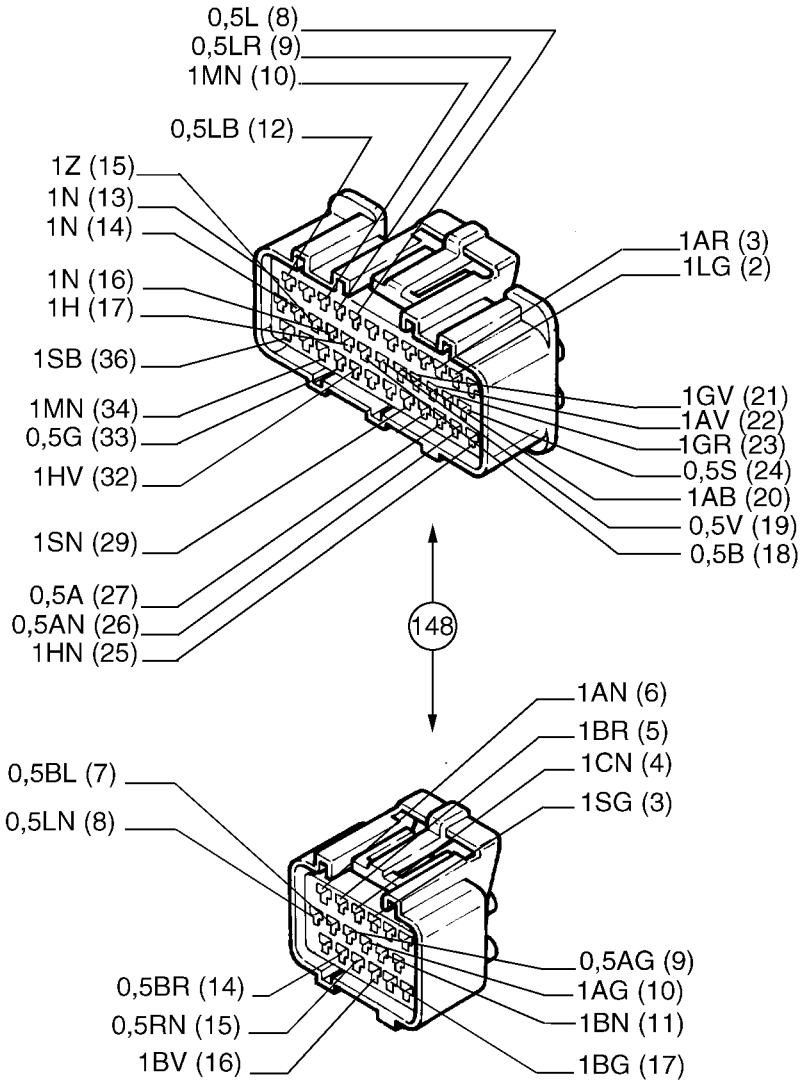


FAULT CODE 36

The frequency signal from the alternator socket (W), engine speed, is not read by the ECU.
Hydraulic clutch calibration cannot be carried out.
Transmission hydraulic performance is not optimal.



FAULT CODE 36



FAULT CODE 37

The wiring on the clutch pedal double switch (1) is disconnected or the switch is faulty.

The tractor is not operative.

Turn the starter key to the OFF position.
Remove the left-hand panel under the dashboard.
Are connection (126) and/or the switch wiring connected?

NO → Connect the connection and/or wiring.

YES

Disconnect connection (126) on the switch.
Using a digital tester, check the double switch.
Does it work?

NO → Replace switch.

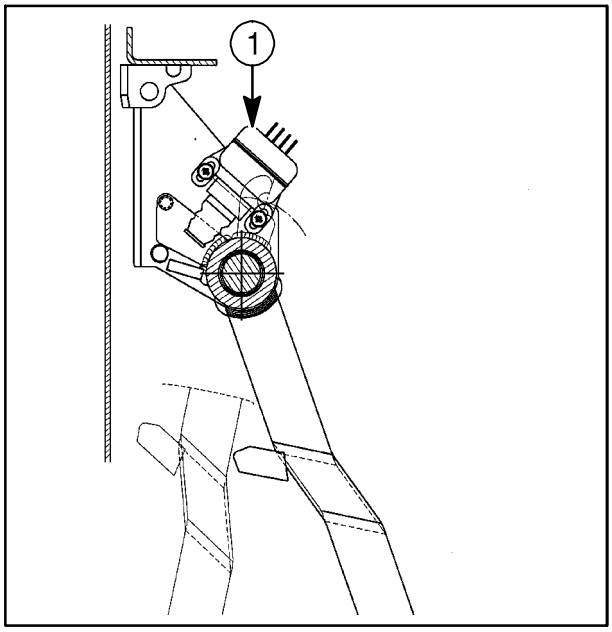
YES

Is there electrical continuity between pin CN1-15 (RN) on connections (148) and pin 3 (RN) on connection (126) of the switch?

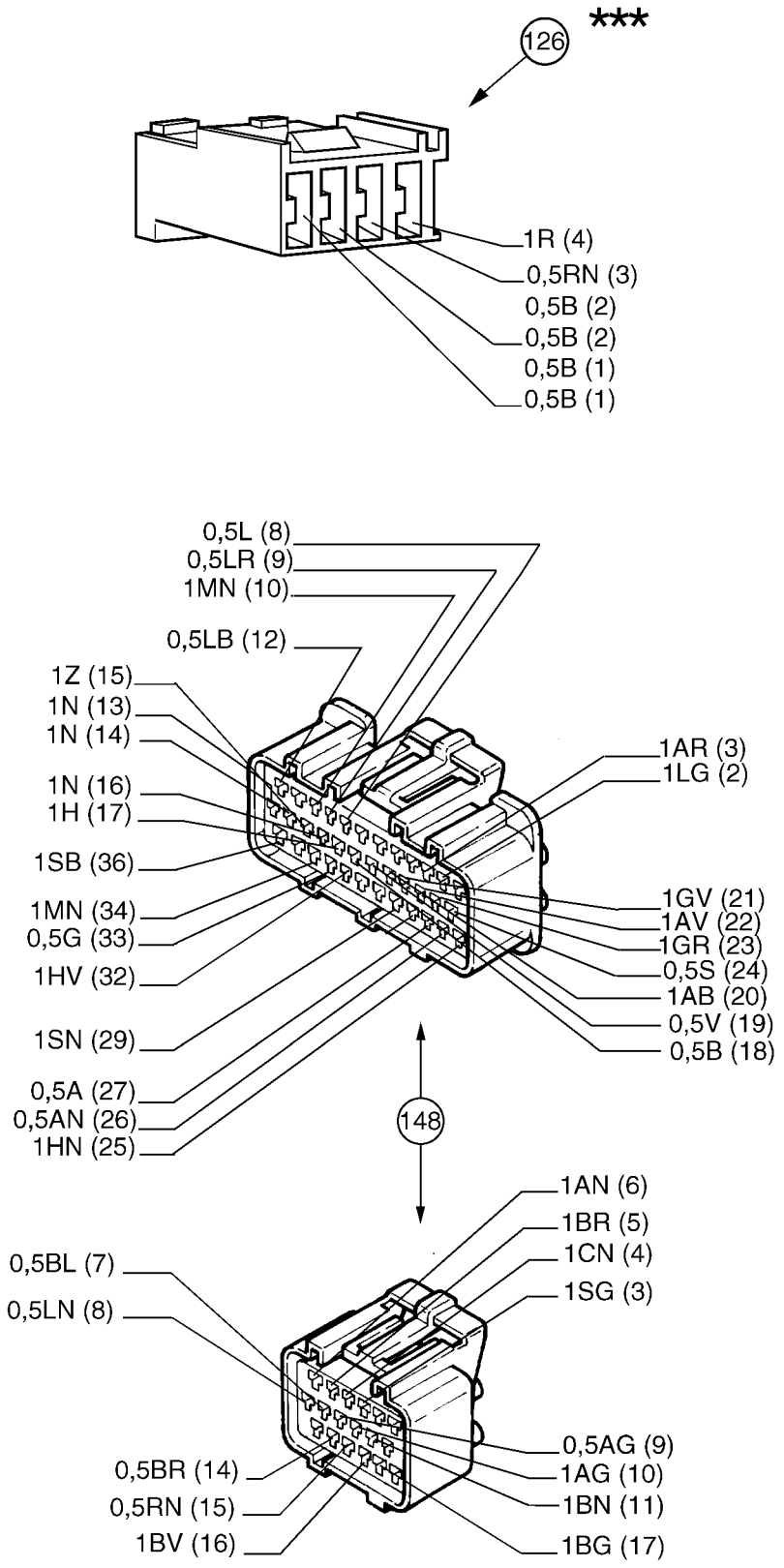
NO → Check the wiring and eliminate the cause of the open circuit.

YES

Replace the ECU.



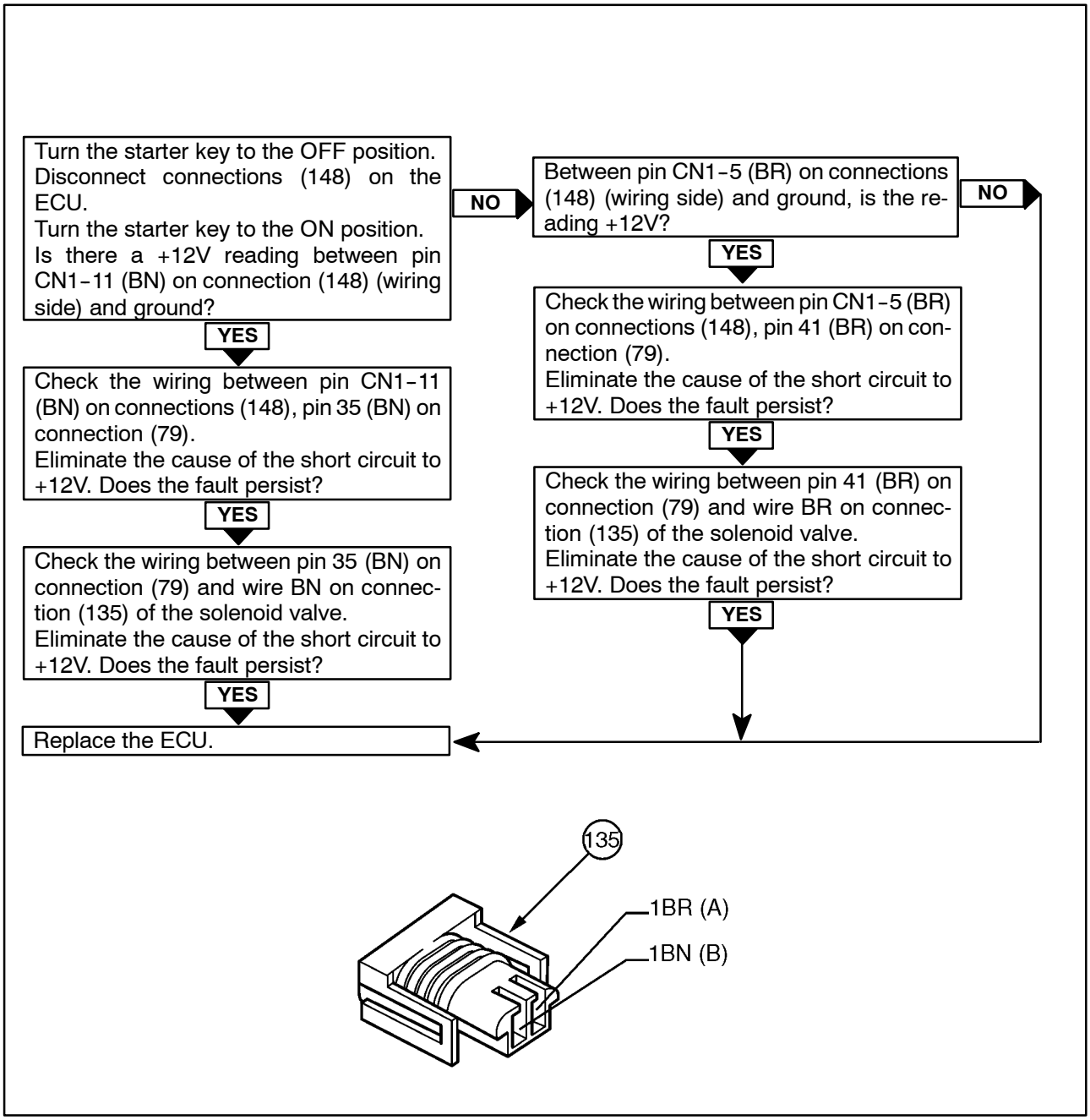
FAULT CODE 37



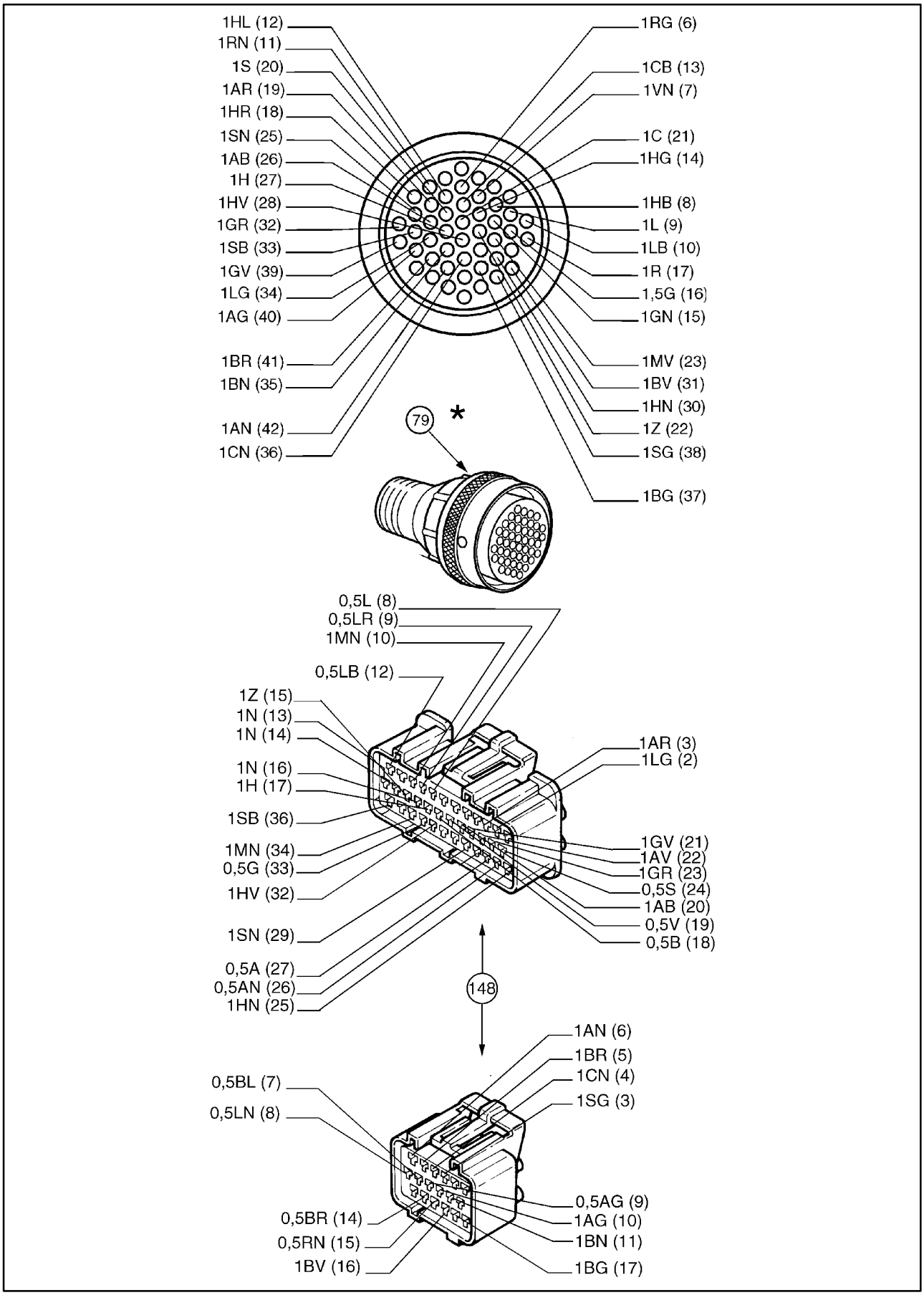
FAULT CODE 38

The wiring on solenoid valve (12, page 10) of clutch (B) (5, page 8) is in short to +12V (power supply) or the ECU is faulty.

The tractor is not operative.



FAULT CODE 38



FAULT CODE 39

The wiring on solenoid valve (12, page 10) of clutch (B) (5, page 8) is disconnected or in short to ground or the solenoid valve is faulty.

The tractor only runs in forward gear.

Turn the starter key to the OFF position. Remove the rear left-hand wheel and the solenoid valve unit guard. Disconnect connection (135) on the solenoid valve of clutch (B). Using a digital tester, measure the electrical resistance of the solenoid valve coil. Is the resistance ~ 10 Ω?

NO → Replace the solenoid valve coil if interrupted.

YES

Check the wiring between connection (135) wire (BN) and pin 35 on connection (79). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

Check the wiring between pin 35 on connection (79) and pin CN1-11 on connections (148). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

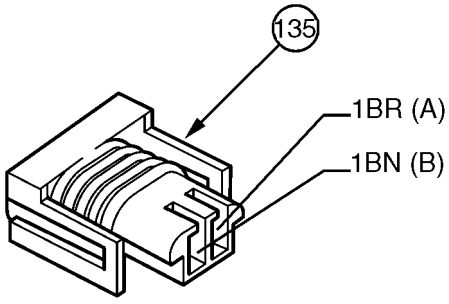
Check the wiring between connection (135) wire (BR) and pin 41 on connection (79). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

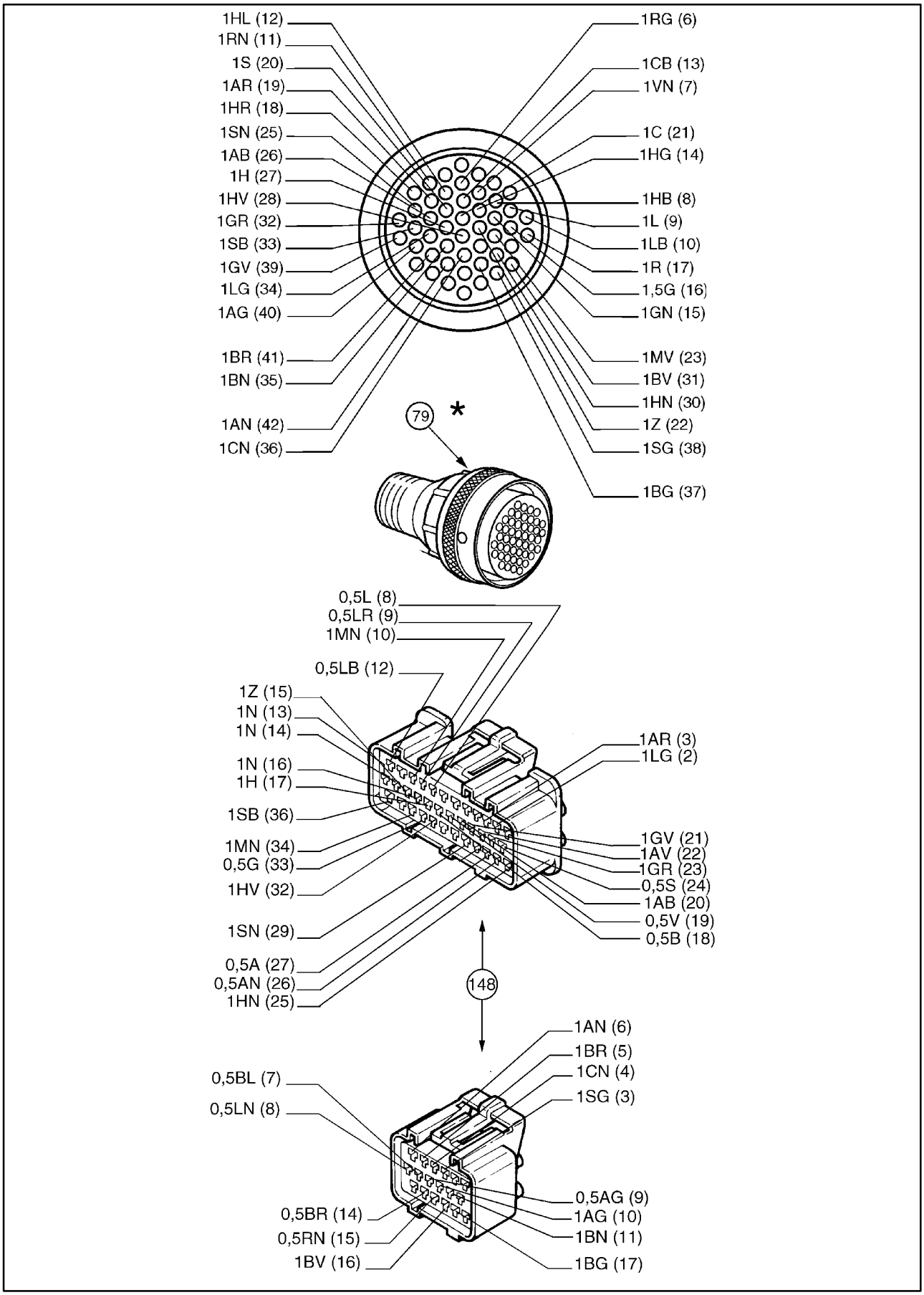
Check the wiring between pin 41 on connection (79) and pin CN1-5 on connections (148). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

Replace the ECU.



FAULT CODE 39



FAULT CODE 41

The wiring on solenoid valve (13, page 10) of clutch (A) (3, page 8) is disconnected or in short to ground or the solenoid valve is faulty.

The tractor only runs in forward gear.

Turn the starter key to the OFF position. Remove the rear left-hand wheel and the solenoid valve unit guard. Disconnect connection (134) on the solenoid valve of clutch (A). Using a digital tester, measure the electrical resistance of the solenoid valve coil. Is the resistance ~ 10 Ω?

NO → Replace the solenoid valve coil if interrupted.

YES

Check the wiring between connection (134) wire (AG) and pin 40 on connection (79). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

Check the wiring between pin 40 on connection (79) and pin CN1-10 on connections (148). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

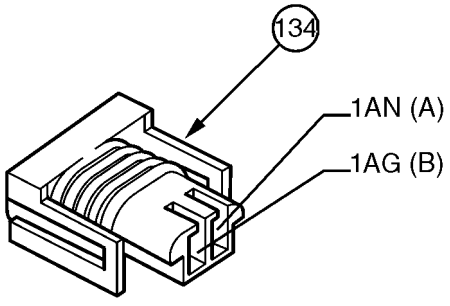
Check the wiring between connection (134) wire (AN) and pin 42 on connection (79). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

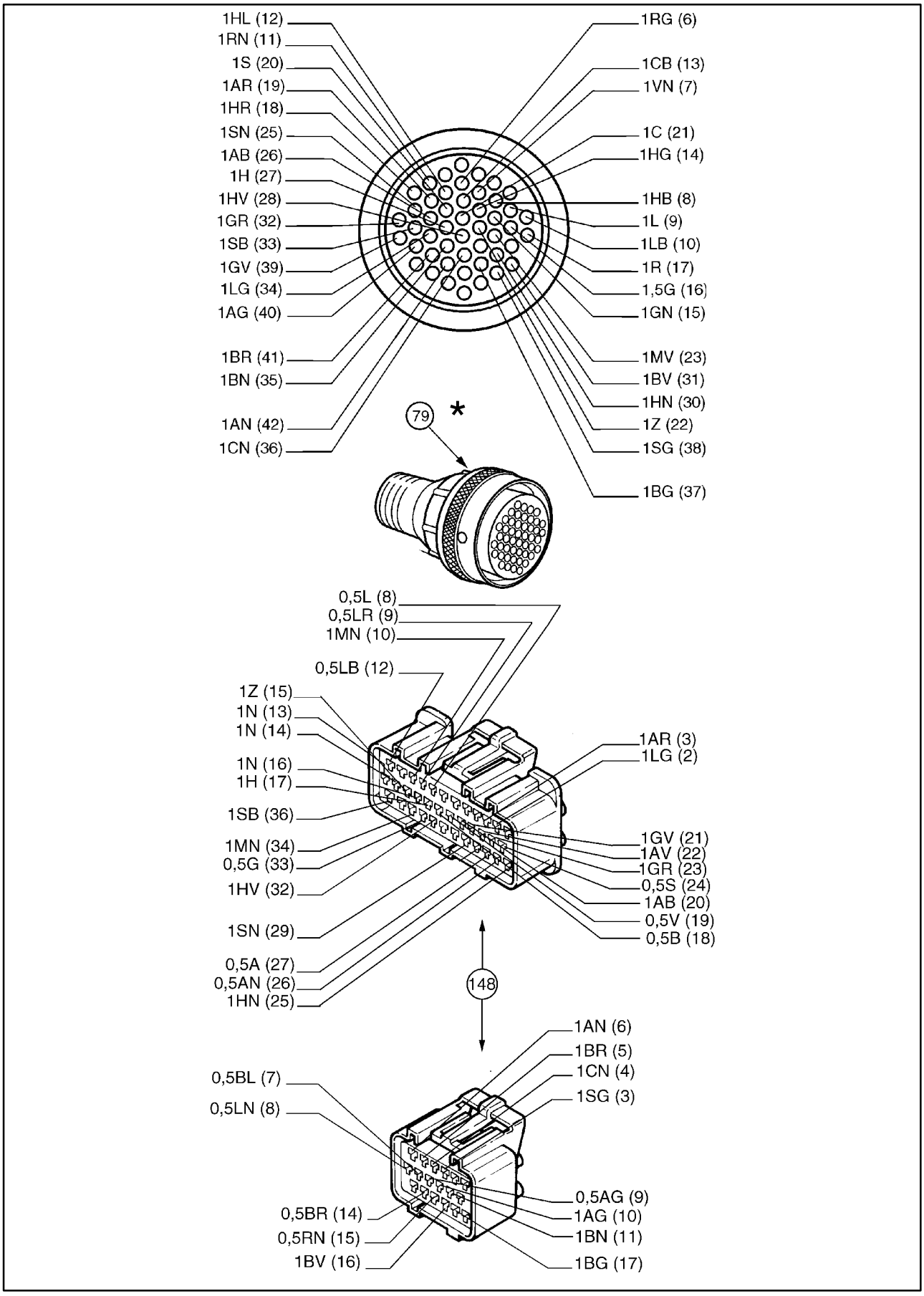
Check the wiring between pin 42 on connection (79) and pin CN1-6 on connections (148). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

Replace the ECU.



FAULT CODE 41



FAULT CODE 42

The wiring on solenoid valve (13, page 10) of clutch (A) (3, page 8) is in short to +12V or the ECU is faulty.
The tractor is not operative.

Turn the starter key to the OFF position.
Disconnect connections (148) on the ECU.
Turn the starter key to the ON position.
Between pin CN1-10 (AG) on connections (148) (wiring side) and ground, is the reading +12V?

NO

Between pin CN1-6 (AN) on connections (148) (wiring side) and ground, is the reading +12V?

NO

YES

Check the wiring between pin CN1-6 (AN) on connections (148) and pin 42 (AN) on connection (79).
Eliminate the cause of the short circuit to +12V. Does the fault persist?

YES

Check the wiring between pin 42 (AN) on connection (79) and wire AN on connection (134) of the solenoid valve.
Eliminate the cause of the short circuit to +12V. Does the fault persist?

YES

YES

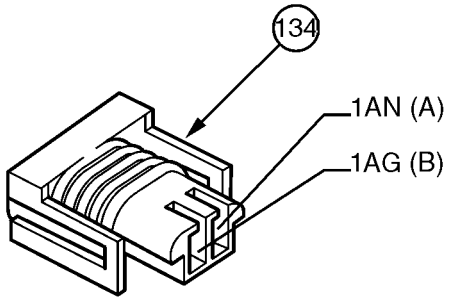
Check the wiring between pin CN1-10 (AG) on connections (148) and pin 40 (AG) on connection (79).
Eliminate the cause of the short circuit to +12V. Does the fault persist?

YES

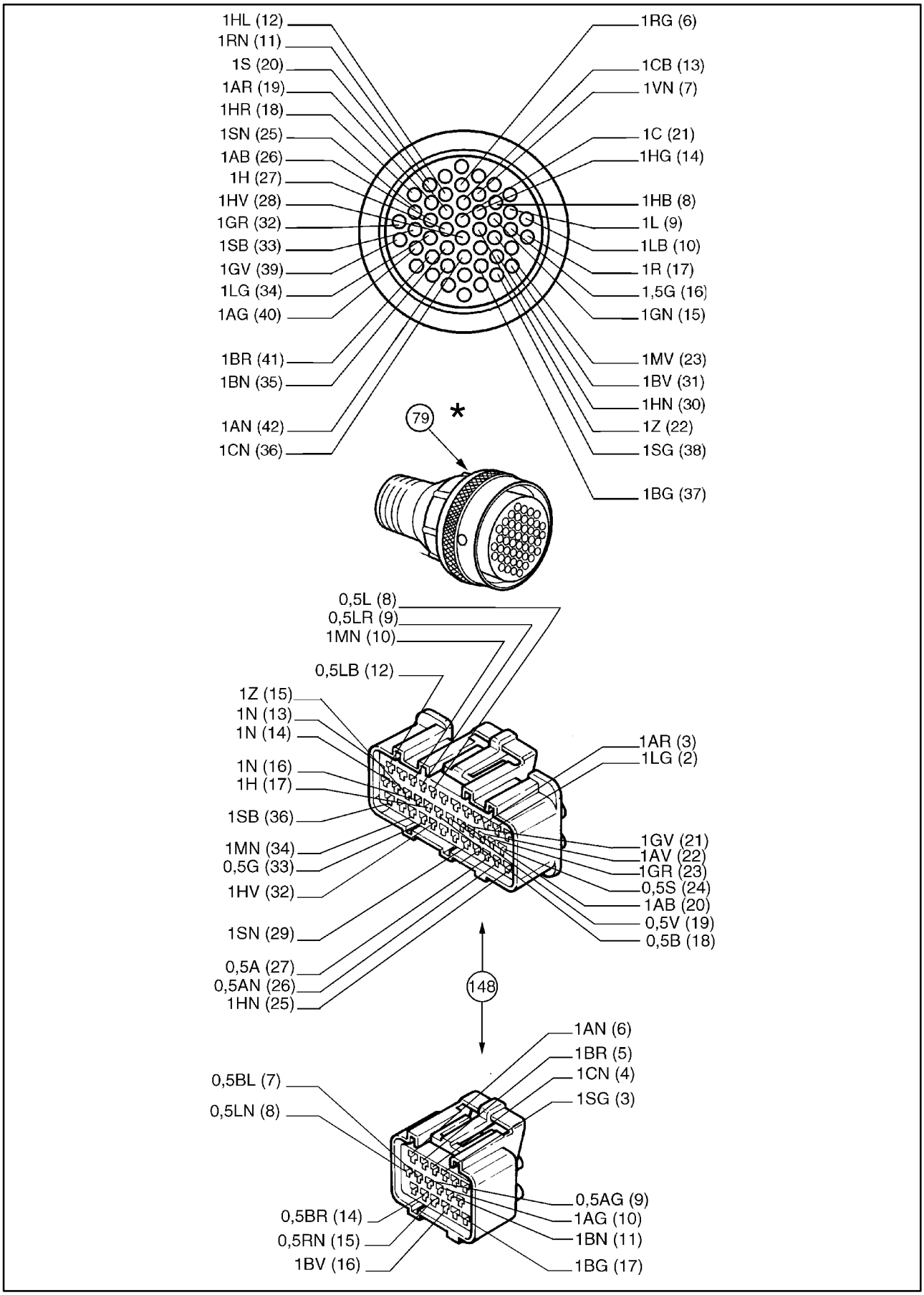
Check the wiring between pin 40 (AG) on connection (79) and wire AG on connection (134) of the solenoid valve.
Eliminate the cause of the short circuit to +12V. Does the fault persist?

YES

Replace the ECU.



FAULT CODE 42



FAULT CODE 43

The pressure in solenoid valve (12, page 10) of clutch (B) (5, page 8) does not drop below 3 bars after a change from reverse to forward gear selection.

The transmission cannot be used.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel and the solenoid valve unit guard.
Remove solenoid valve B and check operation and rod movement. In any event, try replacing the solenoid valve. Does the problem persist?

NO → Replace the solenoid valve coil if in short.

YES

Check the safety pressure switch (133). Does it work correctly?

NO → Replace the pressure switch.

YES

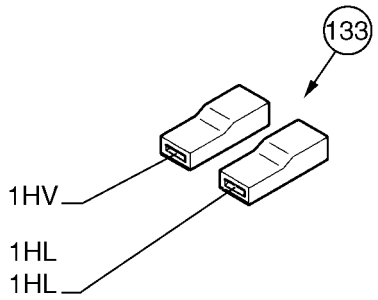
Check the wiring between connection (133), wires HV and HL on the pressure switch, and connection (79) pin 28 (HV) and 12 (HL). Correct any faults. Does the problem persist?

YES

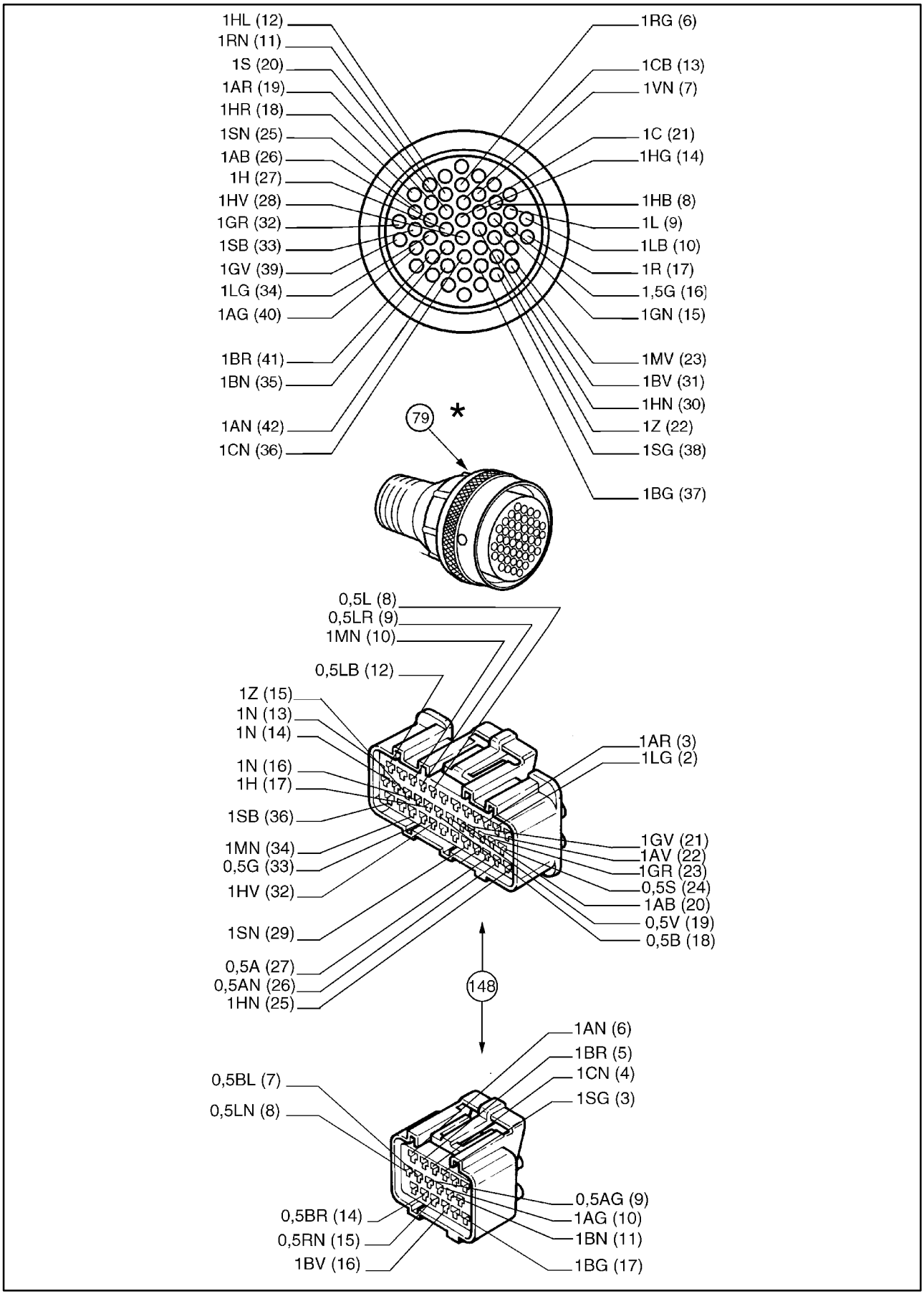
Check the wiring between connection (79) pin 28 (H) and connection (148) CN2-32 (HV). Correct any faults. Does the problem persist?

YES

Replace the ECU.



FAULT CODE 43



FAULT CODE 47

The double switch (1) on the clutch pedal is not correctly positioned/adjusted.

The tractor starting movement may be abrupt.

Connect the connection and/or wiring.

Connect tool **294084** to the diagnosis socket (149) (black), press the H MENU key and turn the starter switch to the ON position, select the HA MENU.
Move the Shuttle lever to forward gear and fully press down the clutch pedal.
When the clutch pedal is released, does the message switch from “OFF” to “ON”?

NO

Remove the left-hand panel under the dashboard.
Are the wiring and connection (126) connected?

NO

YES

Disconnect connection (126) on the switch and check if it works.
Does it work?

NO

YES

Disconnect connections (148) on the ECU.
Is there electrical continuity between pin CN1-15 (RN) on connections (148) and pin 3 (RN) on connection (126) of the switch?

NO

YES

YES

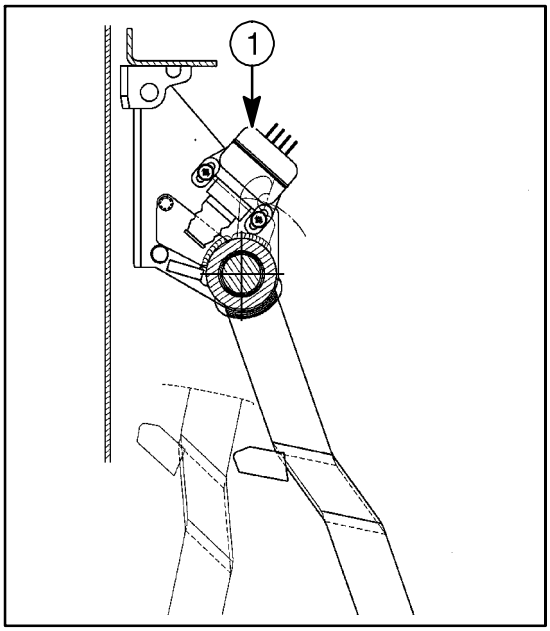
Press the clutch pedal fully down and release slowly.
Does the message switch from “OFF” to “ON” in correspondence to a percentage value of 10 to 15?

NO

Remove the left-hand panel under the dashboard.
Position the double switch on the relative slots, so that the message switches between “OFF” and “ON” in correspondence to a set value (10 to 15%).

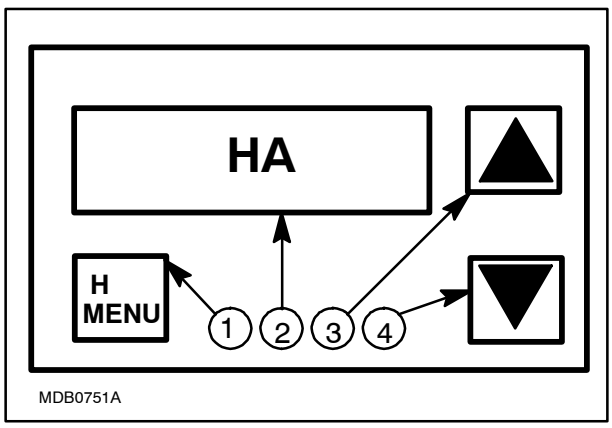
YES

Replace the ECU.

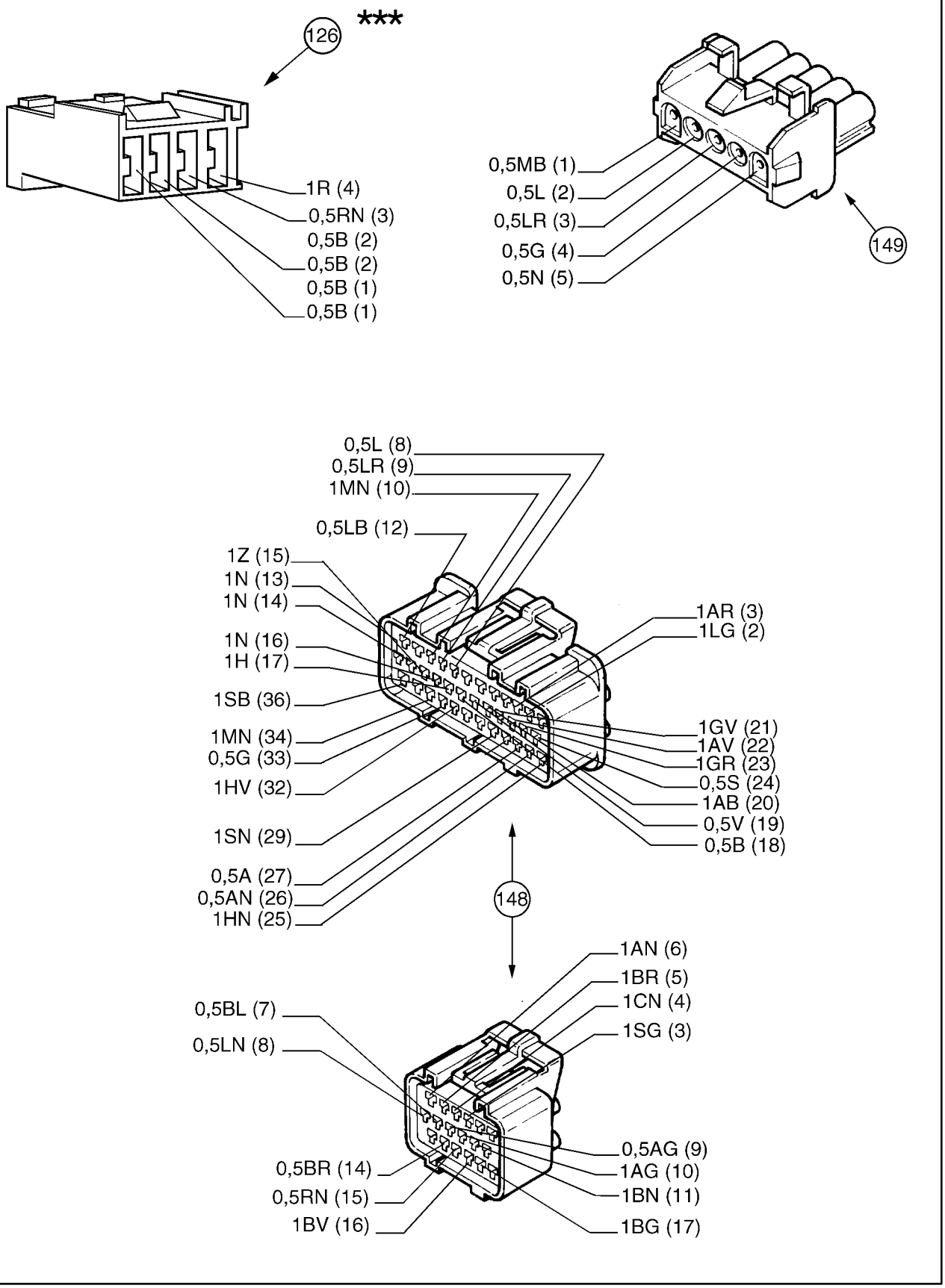


Check the wiring and eliminate the cause of the open circuit.

Replace key switch.



FAULT CODE 47



FAULT CODE 48

The double switch (1) on the clutch pedal is not correctly positioned/adjusted.

The tractor runs but by pressing the clutch pedal the hydraulic clutch solenoid valves may remain powered-up.

Connect tool **294084** to the diagnosis socket (149) (black), press the H MENU key and turn the starter switch to the ON position, select the HA MENU. Move the Shuttle lever to forward gear.
Press and release the clutch pedal, the percentage value displayed is ~ 100 with the "ON" message". By slowly pressing the clutch pedal, does the message switch from "ON" to "OFF" in correspondence to a percentage value of 5 to 8?

NO

Remove the left-hand panel under the dashboard.
Position the double switch on the relative slots, so that the message switches between "ON" and "OFF" in correspondence to a set value (5 to 8%) Does the fault persist?

YES

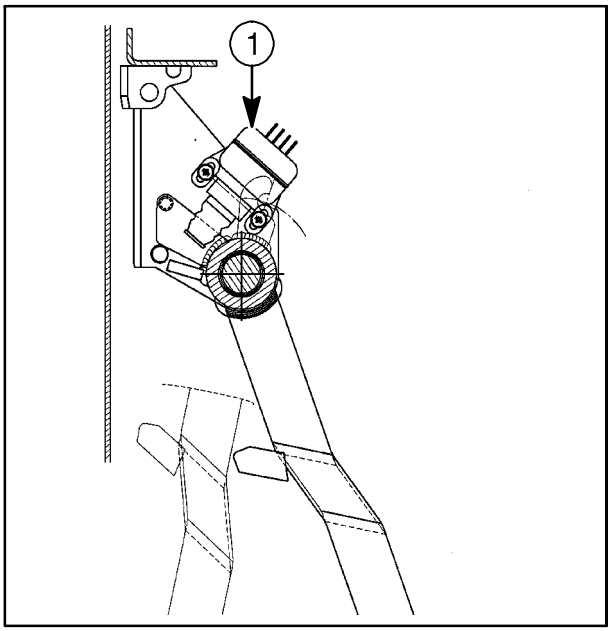
Disconnect connections (148) on the ECU. Examine the switch and check for a short circuit between pin 1 (B) and pin 3 (RN) on connection (126). Also check the wiring for short circuits between pins CN1-15 (RN) and CN2-18 (B) on connections (148).

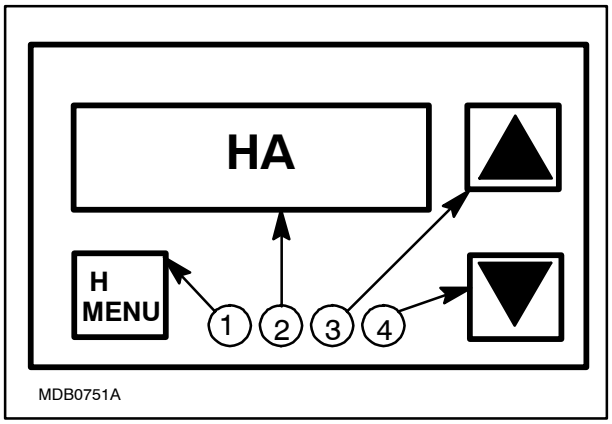
Does the fault persist?

YES

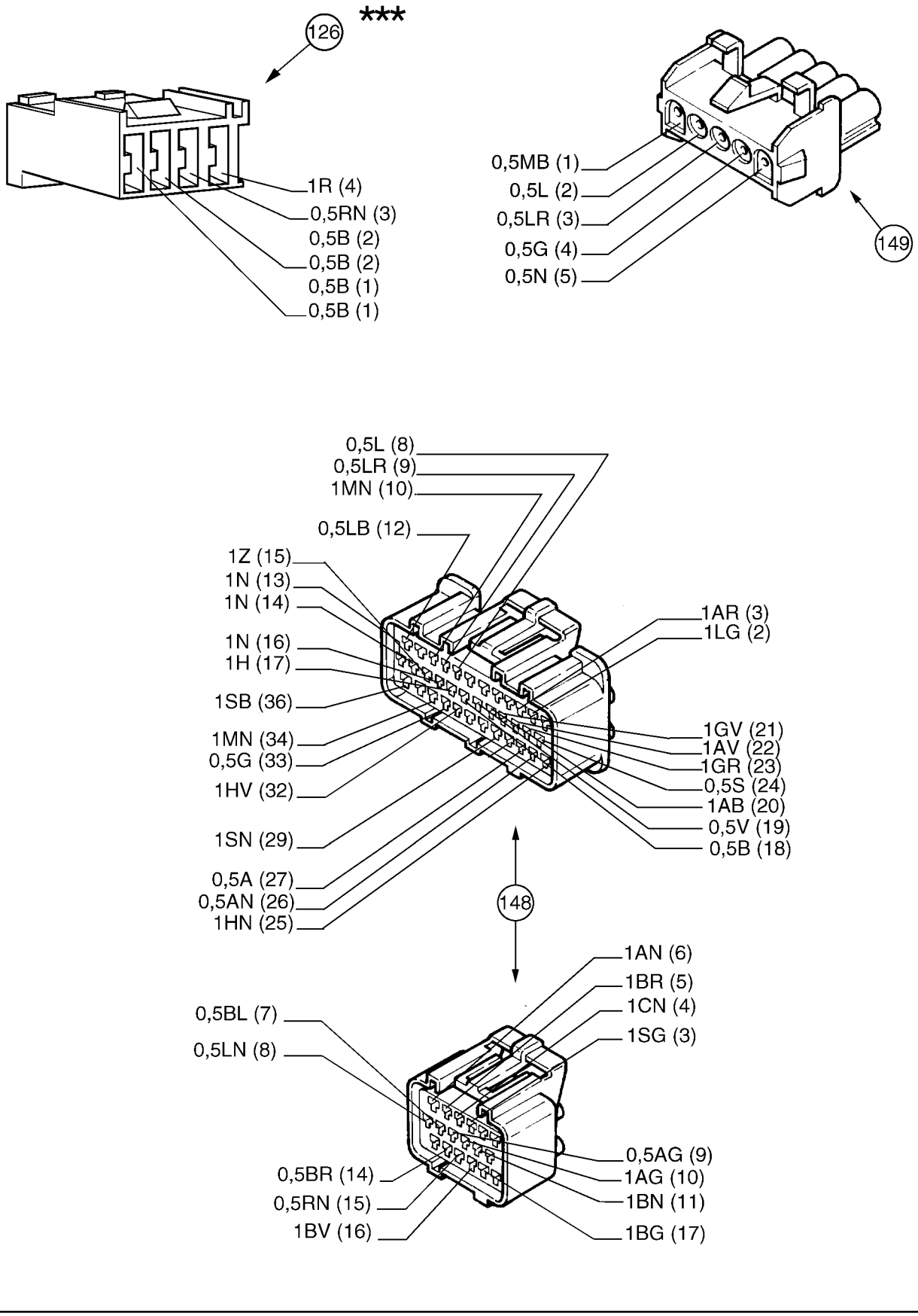
YES

Replace the ECU.





FAULT CODE 48



FAULT CODE 49

The wiring on tractor speed sensor (Y) is disconnected or in short circuit to +12V (power supply).
The tractor runs but may function irregularly.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel.
Are connection (142) and the sensor wiring connected?

NO → Connect the connection and/or wiring.

YES

Disconnect connection (142) on the sensor.
Using a digital tester, measure the sensor electrical resistance.
Is the resistance ~ 700 Ω?

NO → Replace the sensor if interrupted.

YES

Raise engine cover.
Is there electrical continuity between wire (SB) on connection (142) of the sensor and pin 33 (SB) on connection (79)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

Is there electrical continuity between pin 33 on connection (79) (SB) and pin CN2-36 (SB) on connections (148) on the ECU?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

Is there electrical continuity between wire (SN) on connection (142) of the sensor and pin 25 (SN) on connection (79)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

Is there electrical continuity between pin 25 (SN) on connection (79) and pin CN2-29 (SN) on connections (148) of the ECU?

NO → Check the wiring and eliminate the cause of the open circuit.

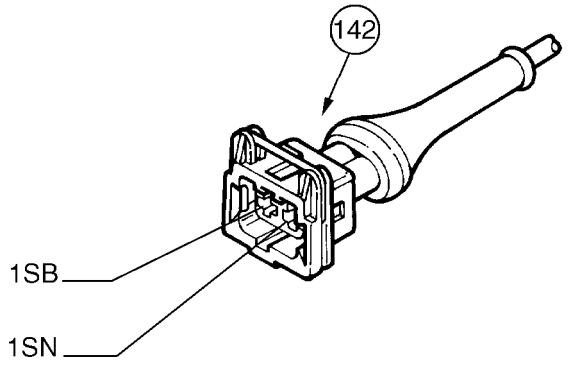
YES

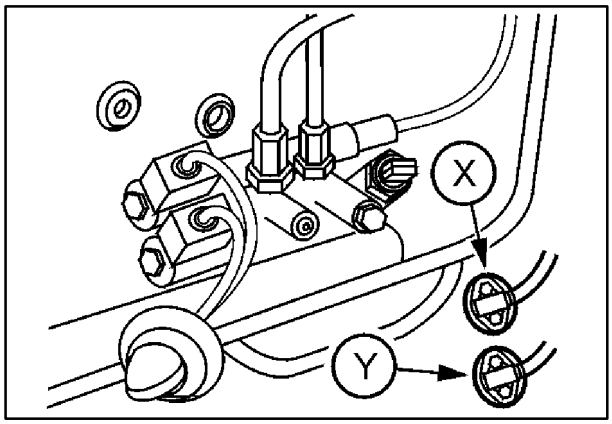
Turn the starter key to the ON position.
Between pin CN2-36 (SB) (wiring side) on connections (148) and ground, is the reading +12V?

NO → Replace the ECU.

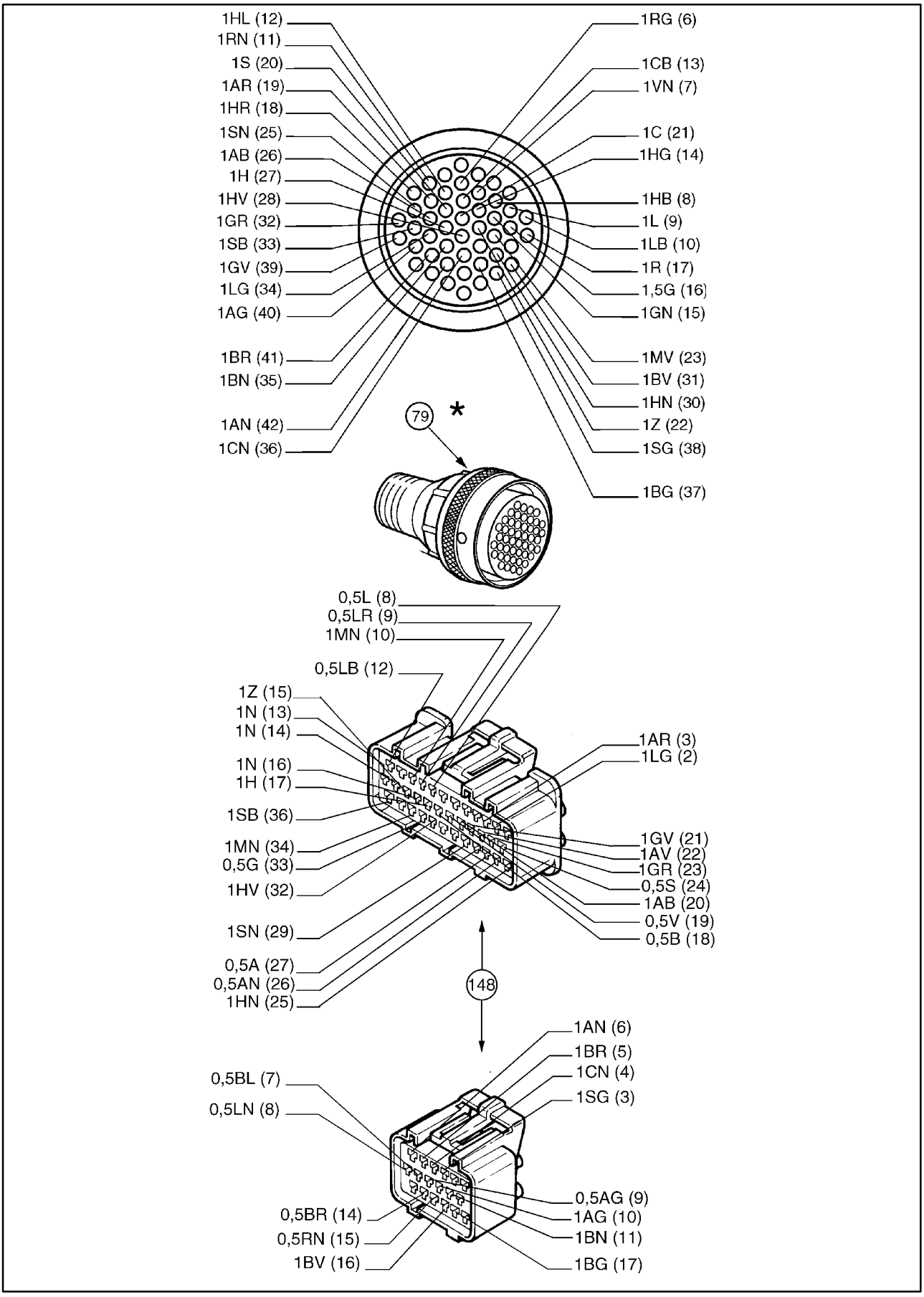
YES

Check the wiring and eliminate the cause of the short to +12V.





FAULT CODE 49



FAULT CODE 51

The wiring on transmission oil temperature sensor is interrupted or in short circuit to +12V (power supply).
The tractor runs but may react abruptly when the oil temperature varies.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel.
Are connection (138) and the sensor wiring connected?

NO → Connect the connection and/or wiring.

YES

Disconnect connection (138) on the sensor.
Using a digital tester, measure the sensor electrical resistance.
With the oil temperature at 68 °F (20 °C), is the resistance ~ 500 Ω?

NO → Replace the sensor if interrupted.

YES

Raise engine cover. Is there electrical continuity between pin (B) (HN) on the sensor wiring and pin 30 on connection (79) (HN)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

Is there electrical continuity between pin 30 on connection (79) and pin CN2-25 on connections (148)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

Is there electrical continuity between pin (A) on the sensor wiring (SN) and pin 25 on connection (79) (SN)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

Is there electrical continuity between pin 25 on connection (79) and pin CN2-29 on connections (148)?

NO → Check the wiring and eliminate the cause of the open circuit.

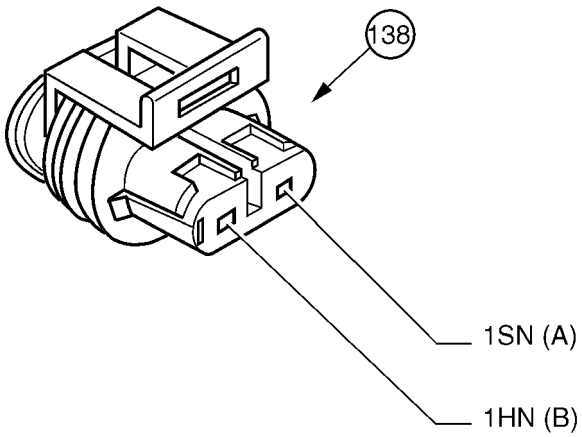
YES

Turn the starter key to the ON position.
Between pin CN2-25 (HN) (wiring side) on connections (148) and ground, is the reading +12V?

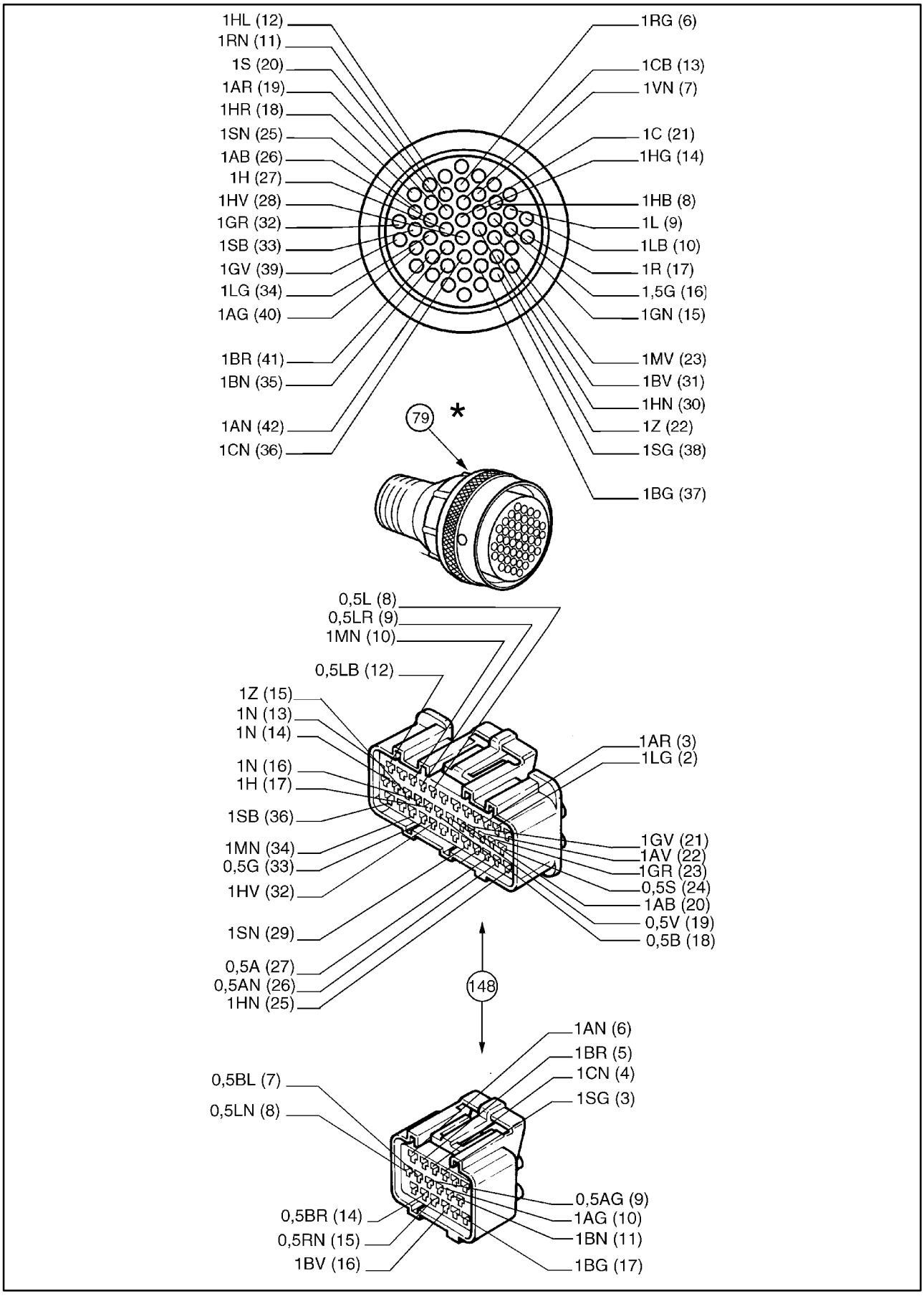
NO → Replace the ECU.

YES

Check the wiring and eliminate the cause of the short to +12V.



FAULT CODE 51



FAULT CODE 52

The wiring on transmission oil temperature sensor is in short circuit or in short circuit to ground.
The tractor runs but may react abruptly when the oil temperature varies.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel.
Are connection (138) and the temperature sensor wiring in short circuit?

NO

Disconnect connection (138) on the sensor.
Using a digital tester, measure the sensor electrical resistance.
With the oil temperature at 68 °F (20 °C), is the resistance ~ 500 Ω?

NO

Replace the sensor if in short.

YES

Check the wiring and eliminate the cause of the short circuit.

YES

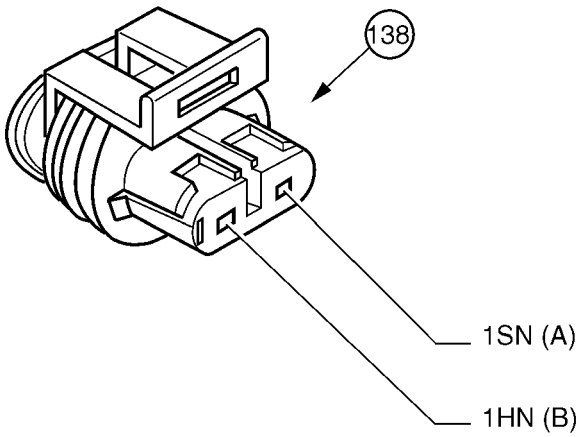
Check the wiring between pin (B) (HN) on connection (138) and pin 30 (HN) on connection (79). Eliminate any open circuits or short circuits to ground. Does the fault persist?

YES

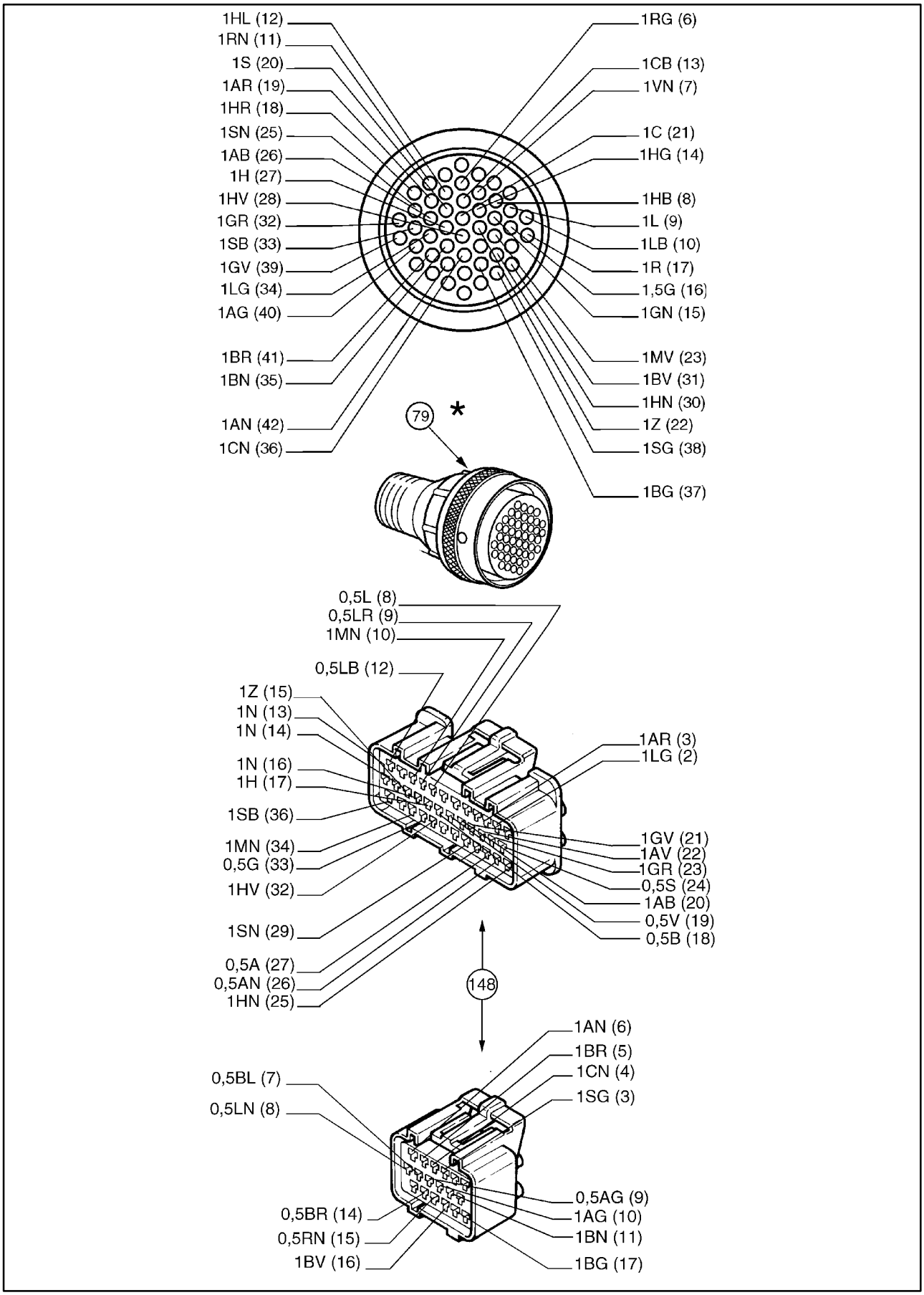
Check the wiring between pin 30 (HN) on connection (79) and pin CN2-25 on connections (148). Eliminate any open circuits or short circuits to ground. Does the fault persist?

YES

Replace the ECU.



FAULT CODE 52



FAULT CODE 53

The sensors supply voltage is much higher than the set value (+5V).

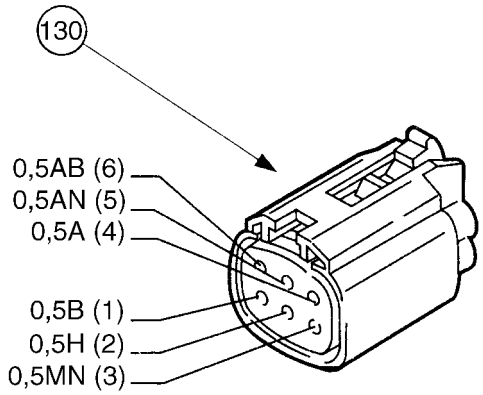
The tractor is not operative.

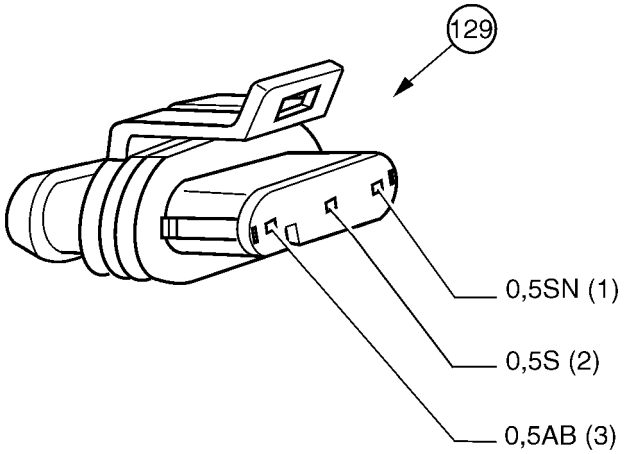
Turn the starter key to the OFF position.
Disconnect connections (148) on the ECU.
Is there a reading of +12V between pin CN2-20 (AB) (wiring side) and ground?

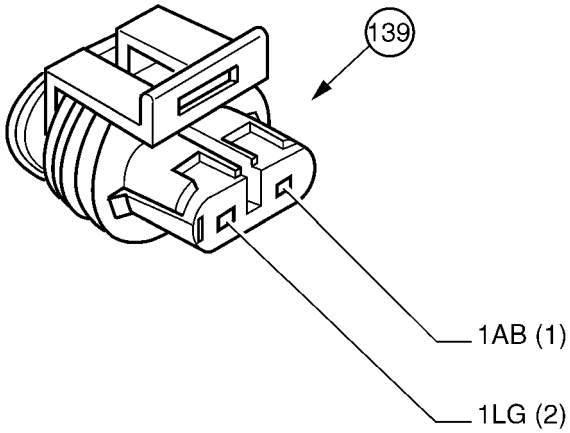
NO → Replace the ECU.

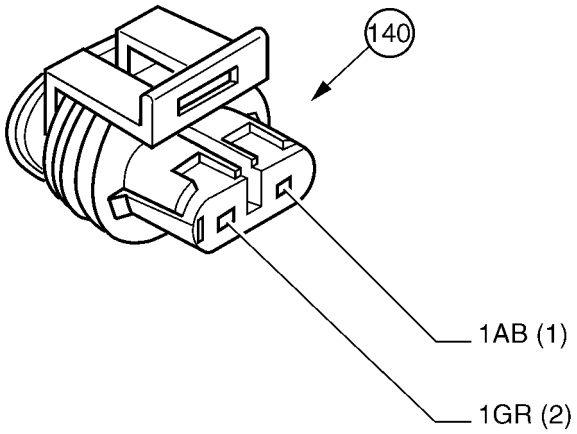
YES

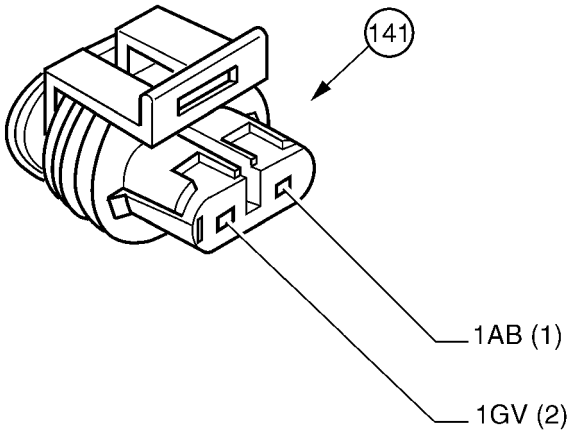
Check the sensor power supply wiring on wire (AB): disconnect the connections (129) (clutch pedal), (130) (Power Shuttle lever), (139) (gear lever position), (141) and (140) (range lever position sensors). Eliminate the cause of the +12V short-circuit, looking for it both on the wiring joining the connections (148) with connection (79) and on the wiring joining connection (79) with the relevant sensor wirings
To facilitate the search, use the diagram shown on page 151.



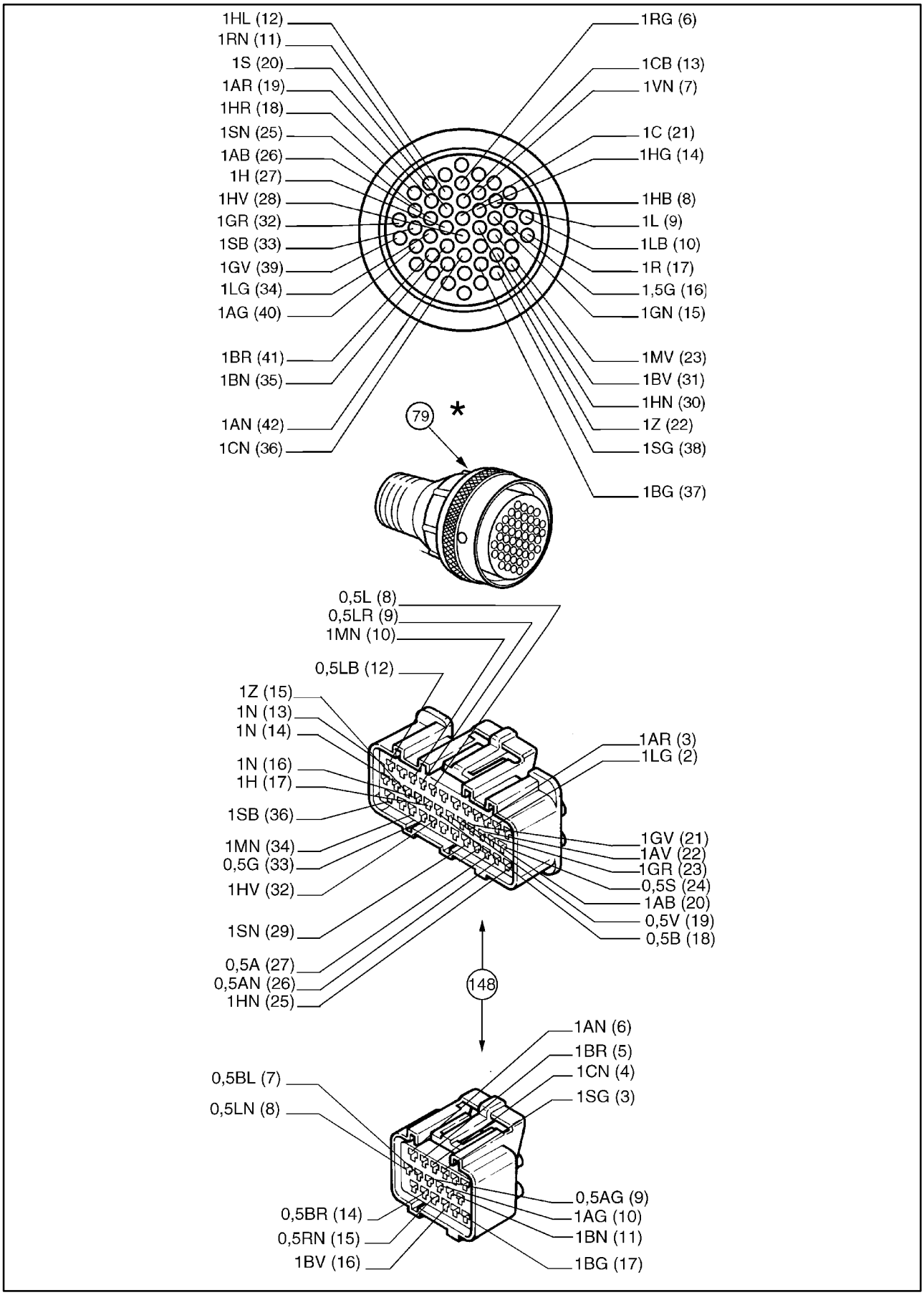








FAULT CODE 53



FAULT CODE 54

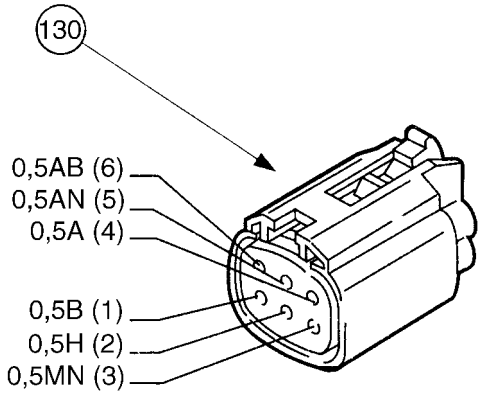
The sensors supply voltage wiring (+5V) is in short to ground or the ECU is faulty.
The tractor is not operative.

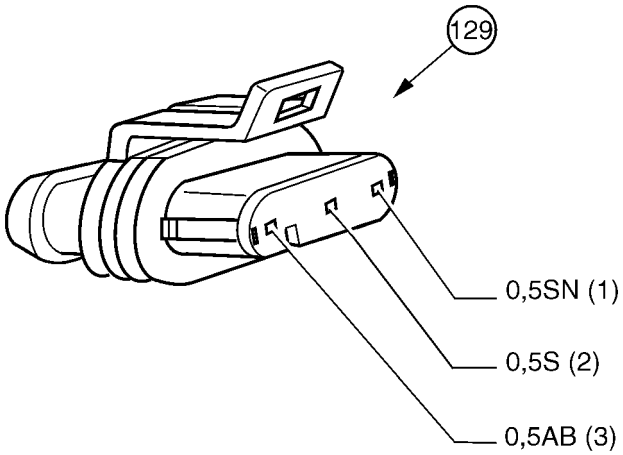
Turn the starter key to the OFF position.
Disconnect connections (148) on the ECU.
Is pin CN2-20 (AB) (wiring side) in short to ground?

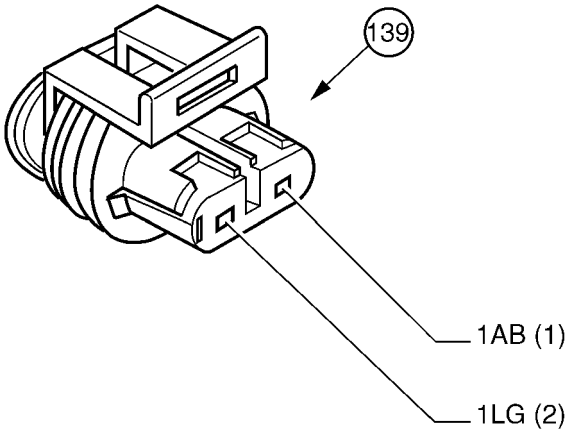
NO → Replace the ECU.

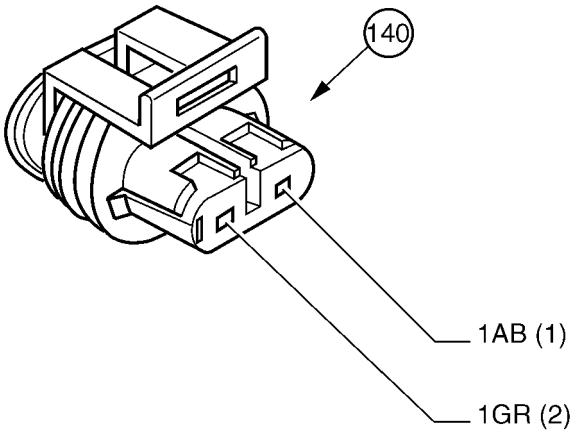
YES

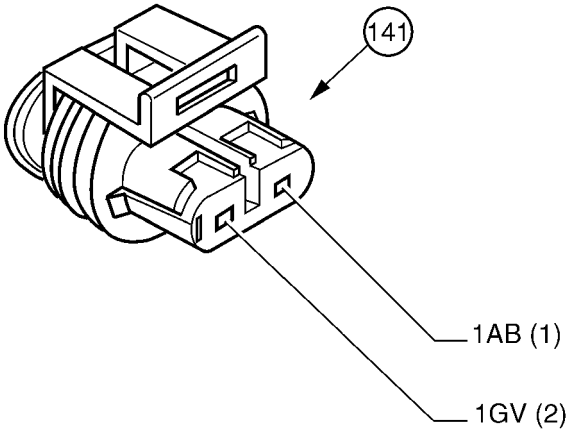
Check the sensors power supply wiring on wire (AB): disconnect the connections (129) (clutch pedal), (130) (Power Shuttle lever), (139) (gear lever position), (141) and (140) (range lever position sensors). Eliminate the cause of the short to ground, looking for it both on the wiring joining the connections (148) with connection (79) and on the wiring joining connection (79) with the relevant sensor wirings
To facilitate the search, use the diagram shown on page 151.



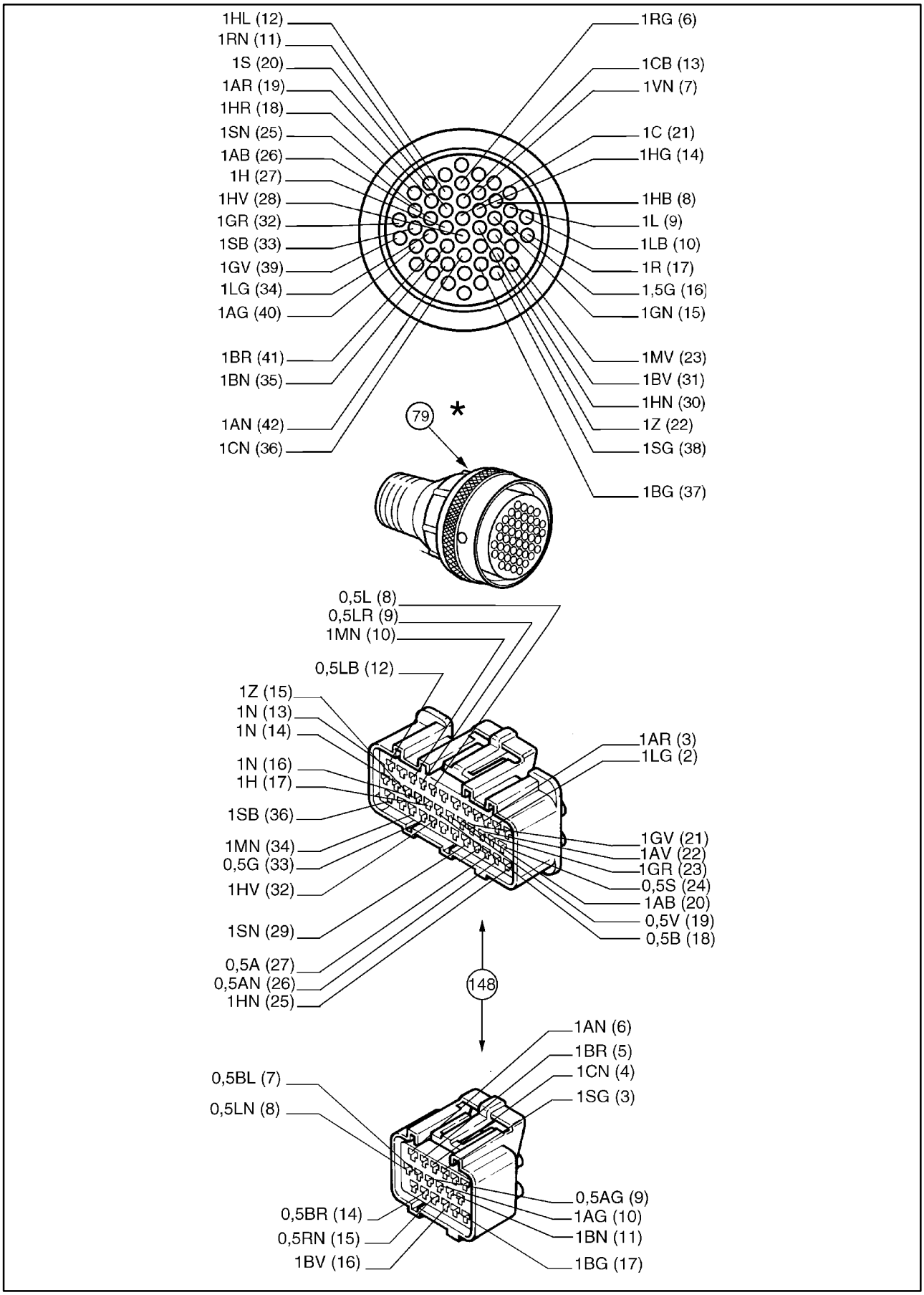








FAULT CODE 54



FAULT CODE 55

The wiring on the Power Shuttle lever (1) is in short circuit.

The tractor runs but may present a slight delay when selecting forward gear.

Turn the starter key to the OFF position. Disconnect connections (148) on the ECU. Position Shuttle control lever (1) in forward gear selection, between pin CN2-20 (AB) and pin CN2-26 (AN) (wiring side), is the reading ~ 600 Ω?

NO → Replace the Shuttle lever.

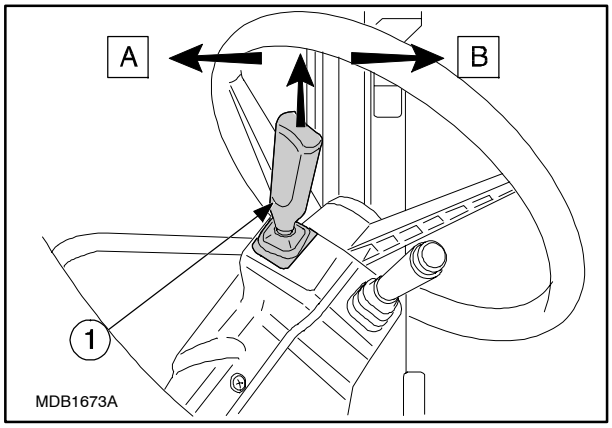
YES

Disconnect connection (130). With the Shuttle lever (1) in forward gear selection, between pin 5 (AN) and pin 6 (AB) on the male connector, is the reading ~ 600 Ω?

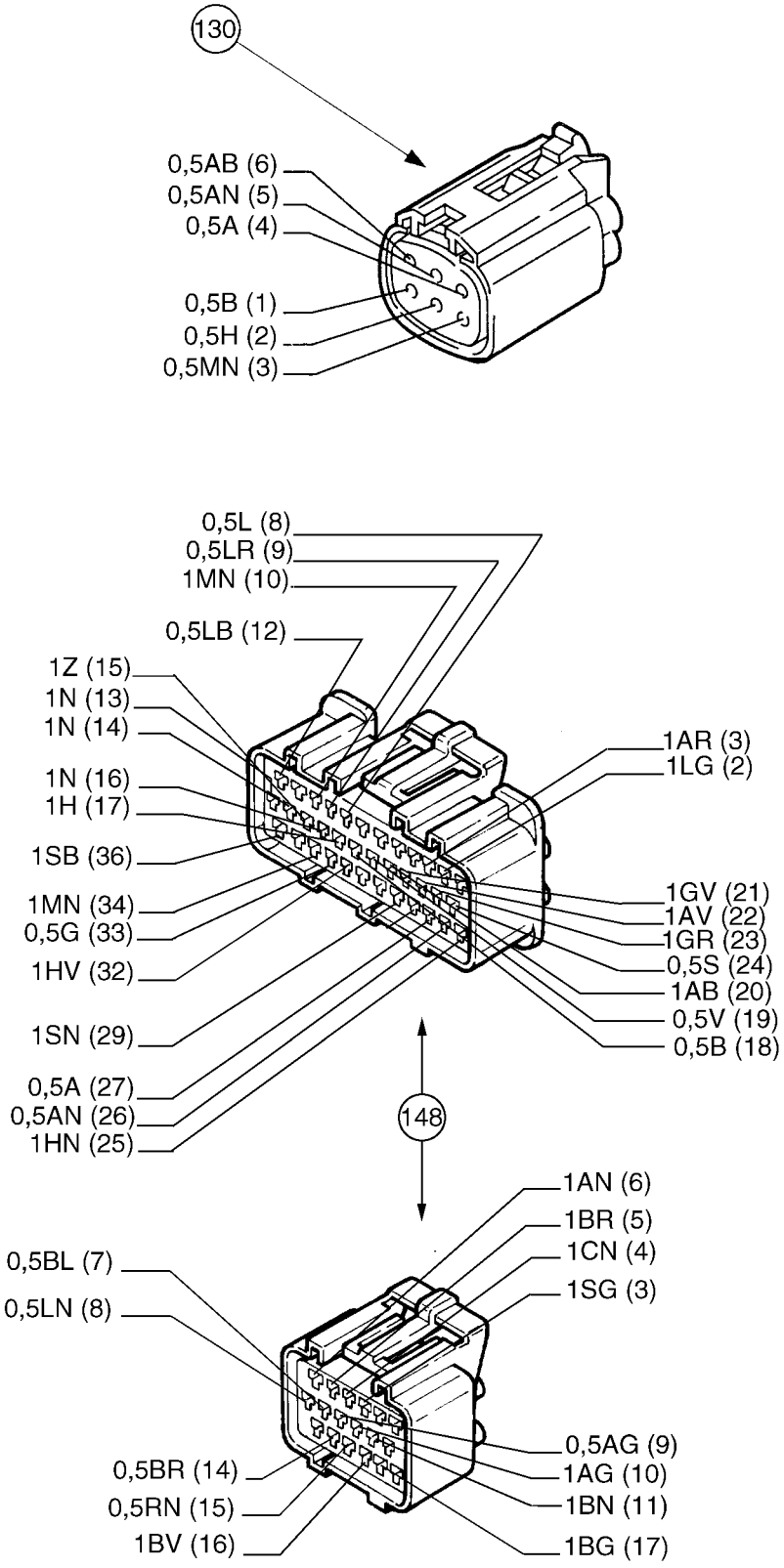
NO → Check the wiring between connector and connection (130) and the Shuttle lever and remove cause of the short circuit

YES

Replace the ECU.



FAULT CODE 55



FAULT CODE 56

The Power Shuttle lever (1) wiring is disconnected or in short circuit to ground.

The tractor runs but may present a slight delay when selecting forward gear.

Turn the starter key to the OFF position. Disconnect connections (148) on the ECU. Is wire (AN) on pin CN2-26 in short to ground?

NO → Is there electrical continuity between CN2-20 (AB) on connections (148) and corresponding pin 6 (AB) on connection (130)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES → Is there electrical continuity between CN2-26 (AN) on connections (148) and corresponding pin 5 (AN) on connection (130)?

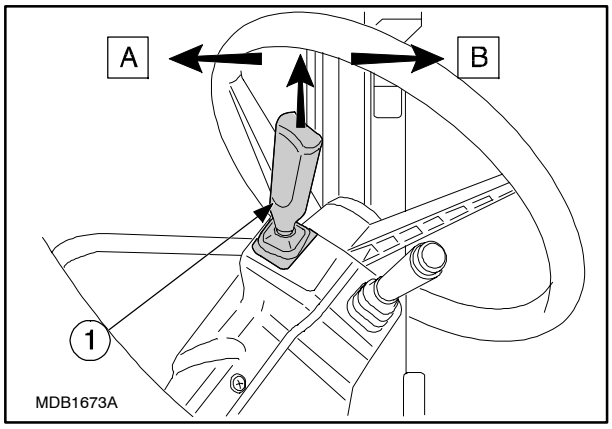
NO → Check the wiring and eliminate the cause of the open circuit.

YES → Replace the Shuttle lever. Does the fault persist?

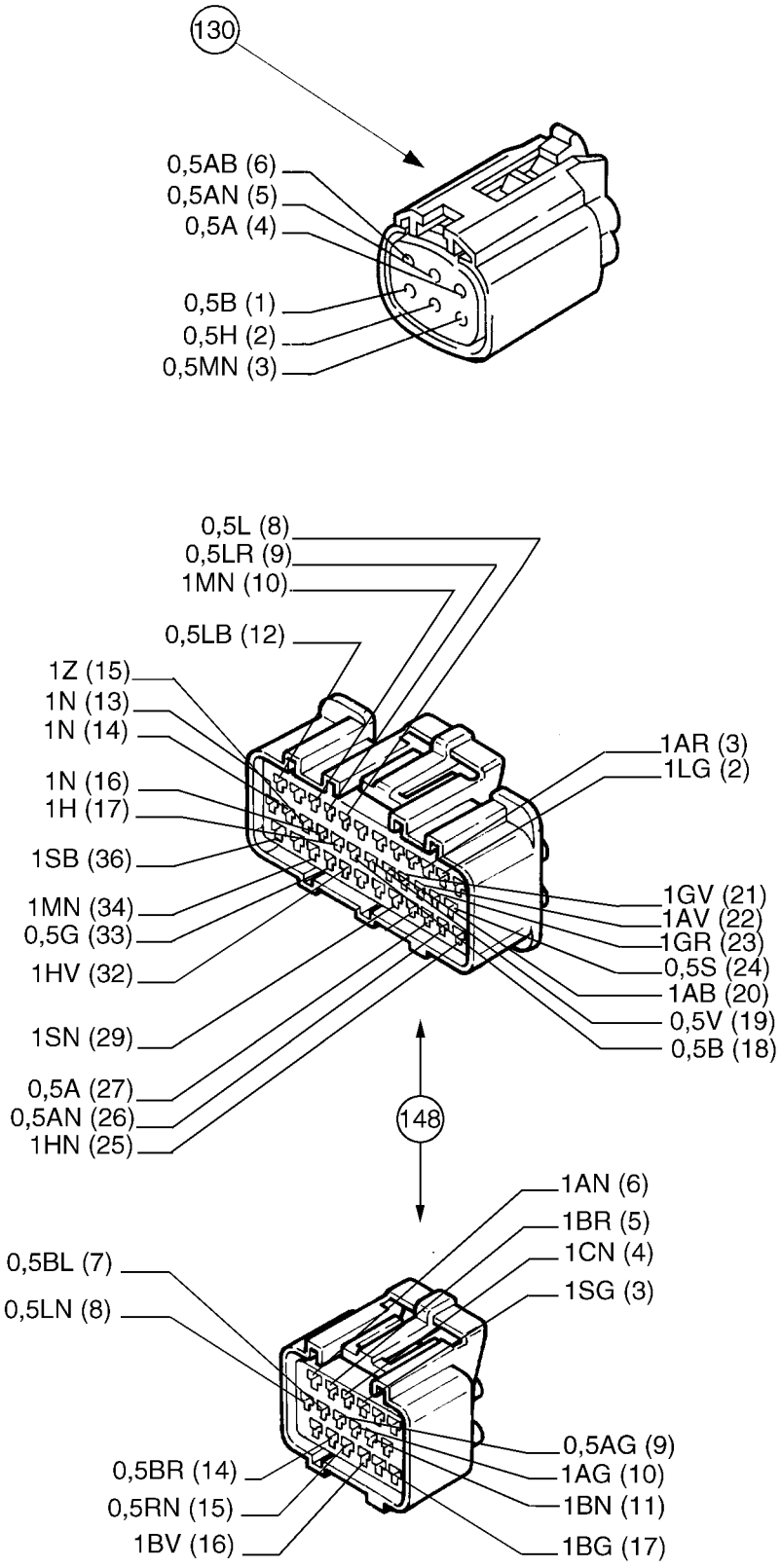
YES → Replace the ECU.

YES → Check the wiring between pin CN2-26 (AN) on connections (148) and connection (130) and the Shuttle lever. Eliminate the cause of the short circuit to ground. Does the fault persist?

YES → Replace the Shuttle lever. Does the fault persist?



FAULT CODE 56



FAULT CODE 57

The wiring on the Power Shuttle lever (1) is in short circuit.

The tractor runs but may present a slight delay in reverse.

Turn the starter key to the OFF position. Disconnect connections (148) on the ECU. Position Shuttle control lever (1) in reverse gear selection, between pin CN2-20 (AB) and pin CN2-27 (A) (wiring side), is the reading ~ 600 Ω?

NO → Replace the Shuttle lever.

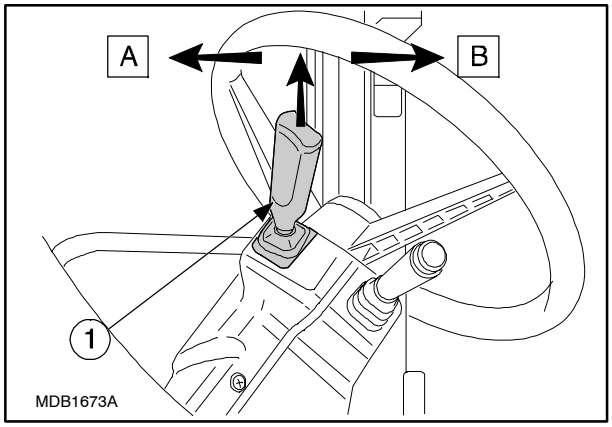
YES

Disconnect connection (130). With Shuttle control lever (1) in reverse gear selection, between pin 4 (A) and pin 6 (AB) on the male connector, is the reading ~ 600 Ω?

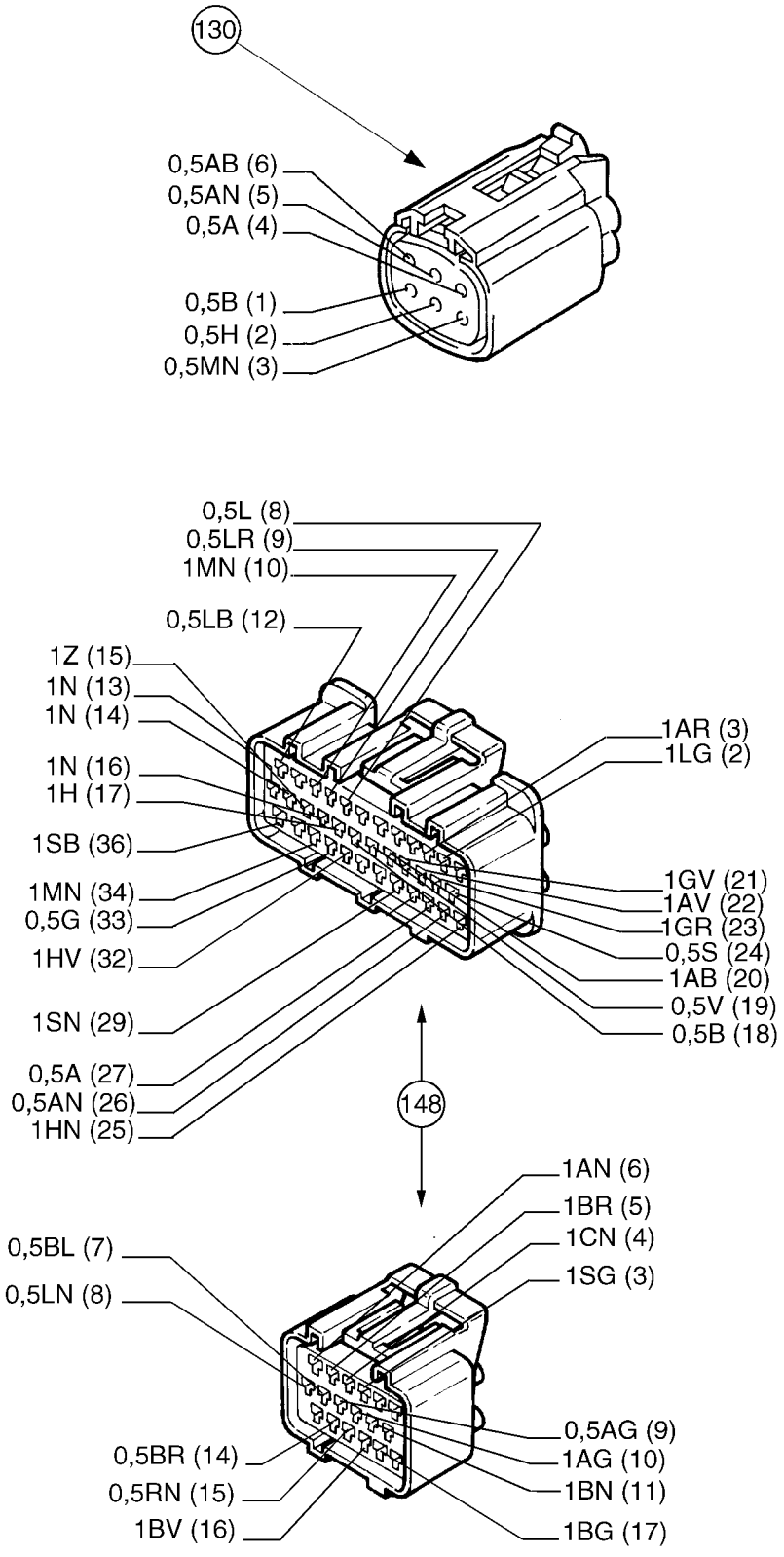
NO → Check the wiring between connector and connection (130) and the Shuttle lever and remove cause of the short circuit

YES

Replace the ECU.



FAULT CODE 57



FAULT CODE 58

The Power Shuttle lever (1) wiring is disconnected or in short circuit to ground.

The tractor runs but may present a slight delay in reverse.

Turn the starter key to the OFF position. Disconnect connections (148) on the ECU. Is wire (A) on pin CN2-27 in short to ground?

NO → Is there electrical continuity between CN2-20 (AB) on connections (148) and corresponding pin 6 (AB) on connection (130)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES → Is there electrical continuity between CN2-27 (A) on connections (148) and corresponding pin 4 (A) on connection (130)?

NO → Check the wiring and eliminate the cause of the open circuit.

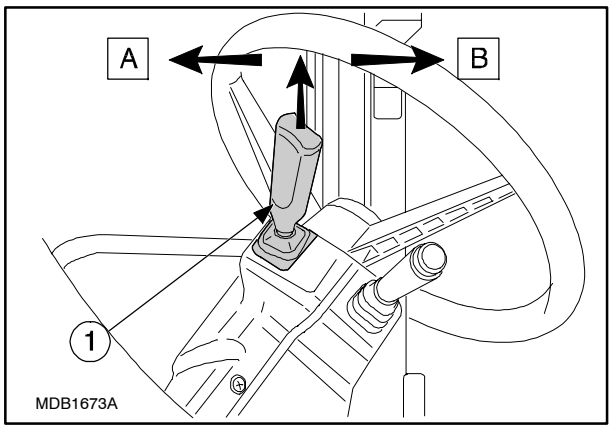
YES → Replace the Shuttle lever. Does the fault persist?

YES → Replace the ECU.

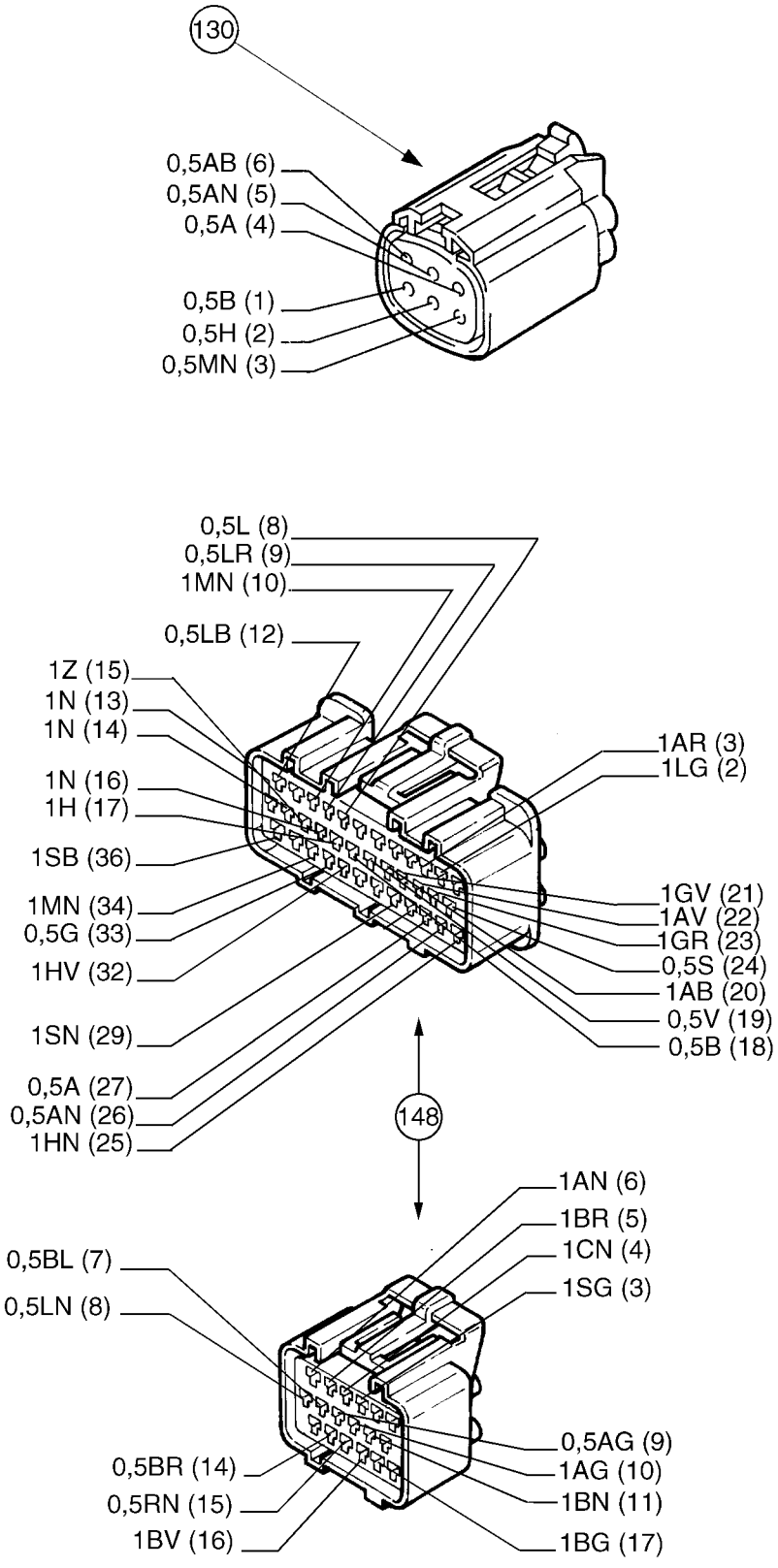
YES → Check the wiring between pin CN2-26 (AN) on connections (148) and connection (130) and the Shuttle lever. Eliminate the cause of the short circuit to ground. Does the fault persist?

YES → Replace the Shuttle lever. Does the fault persist?

YES → Replace the ECU.



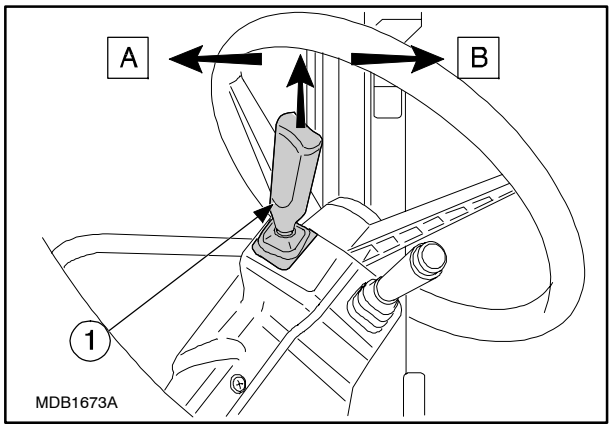
FAULT CODE 58



FAULT CODE 59

The Power Shuttle lever (1) is faulty

Replace the Power Shuttle lever.



FAULT CODE 65

The wiring on solenoid valve (11, page 10) of clutch (C) (7, page 8) is disconnected or in short to ground or the solenoid valve is faulty.

The tractor can be used, but the HIGH - LOW selections are disabled.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel and the solenoid valves unit guard.
Disconnect connection (136) on the solenoid valve of clutch (C).
Using a digital tester, measure the electrical resistance of the solenoid valve coil.
Is the resistance ~ 10 Ω?

NO → Replace the solenoid valve coil if interrupted.

YES

Check the wiring between connection (136) wire (CN) and pin 36 on connection (79). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

Check the wiring between pin 36 on connection (79) and pin CN1-4 on connections (148). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

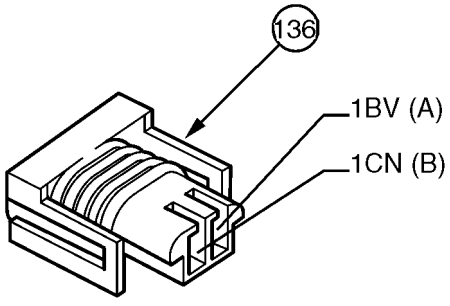
Check the wiring between connection (136) wire (BV) and pin 31 on connection (79). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

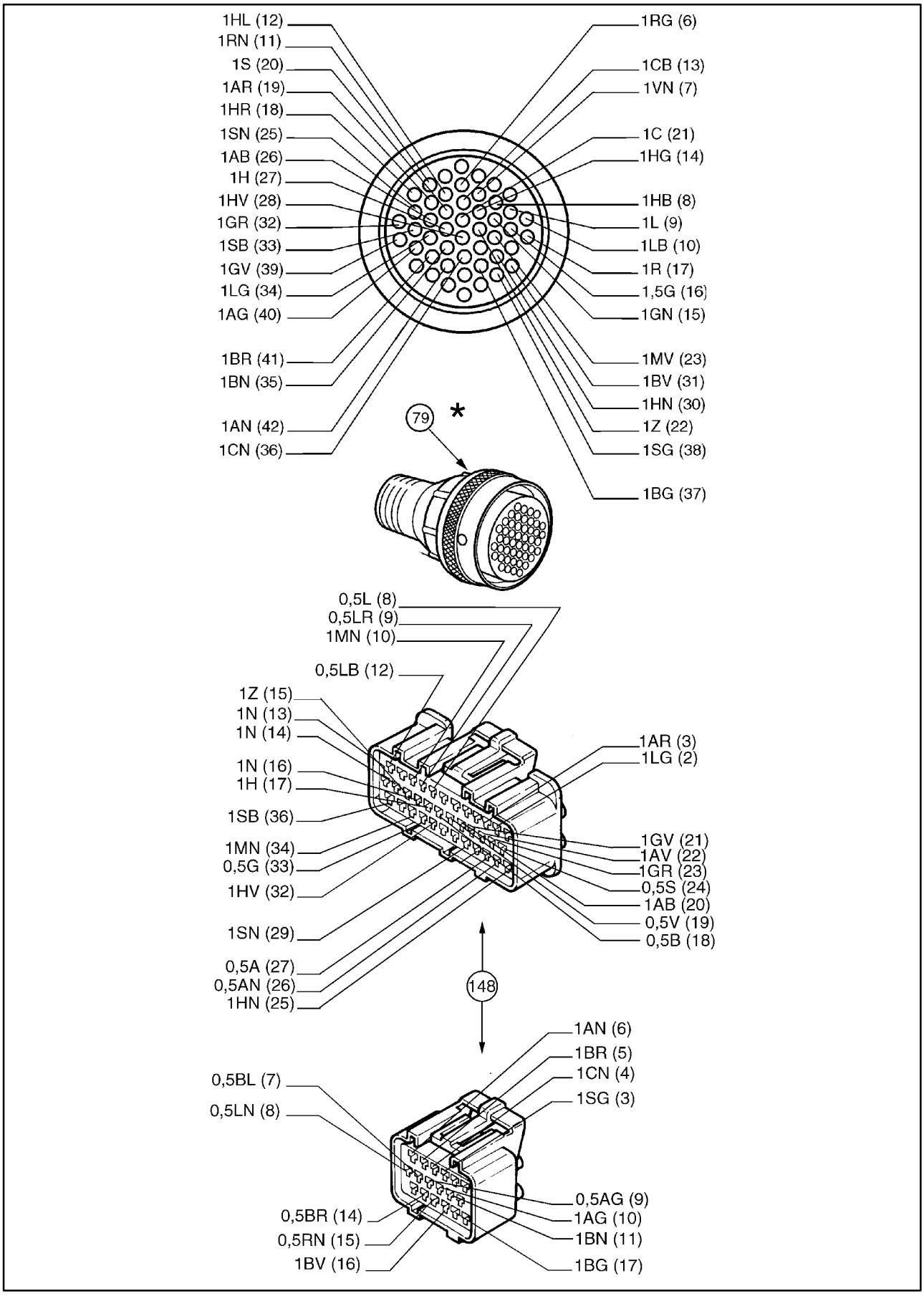
Check the wiring between pin 31 on connection (79) and pin CN1-16 on connections (148). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

Replace the ECU.



FAULT CODE 65



FAULT CODE 66

The wiring on solenoid valve (10, page 10) of clutch (D) (8, page 8) is disconnected or in short to ground or the solenoid valve is faulty.

The tractor can be used, but the HIGH - LOW selections are disabled.

Turn the starter key to the OFF position. Remove the rear left-hand wheel and the solenoid valve unit guard. Disconnect connection (137) on the solenoid valve of clutch (D). Using a digital tester, measure the electrical resistance of the solenoid valve coil. Is the resistance ~ 10 Ω?

NO → Replace the solenoid valve coil if interrupted.

YES

Check the wiring between connection (137) wire (BG) and pin 37 on connection (79). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

Check the wiring between pin 37 on connection (79) and pin CN1-17 on connections (148). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

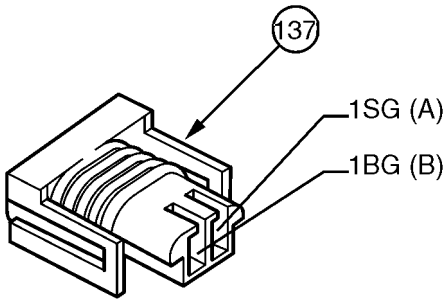
Check the wiring between connection (137) wire (SG) and pin 38 on connection (79). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

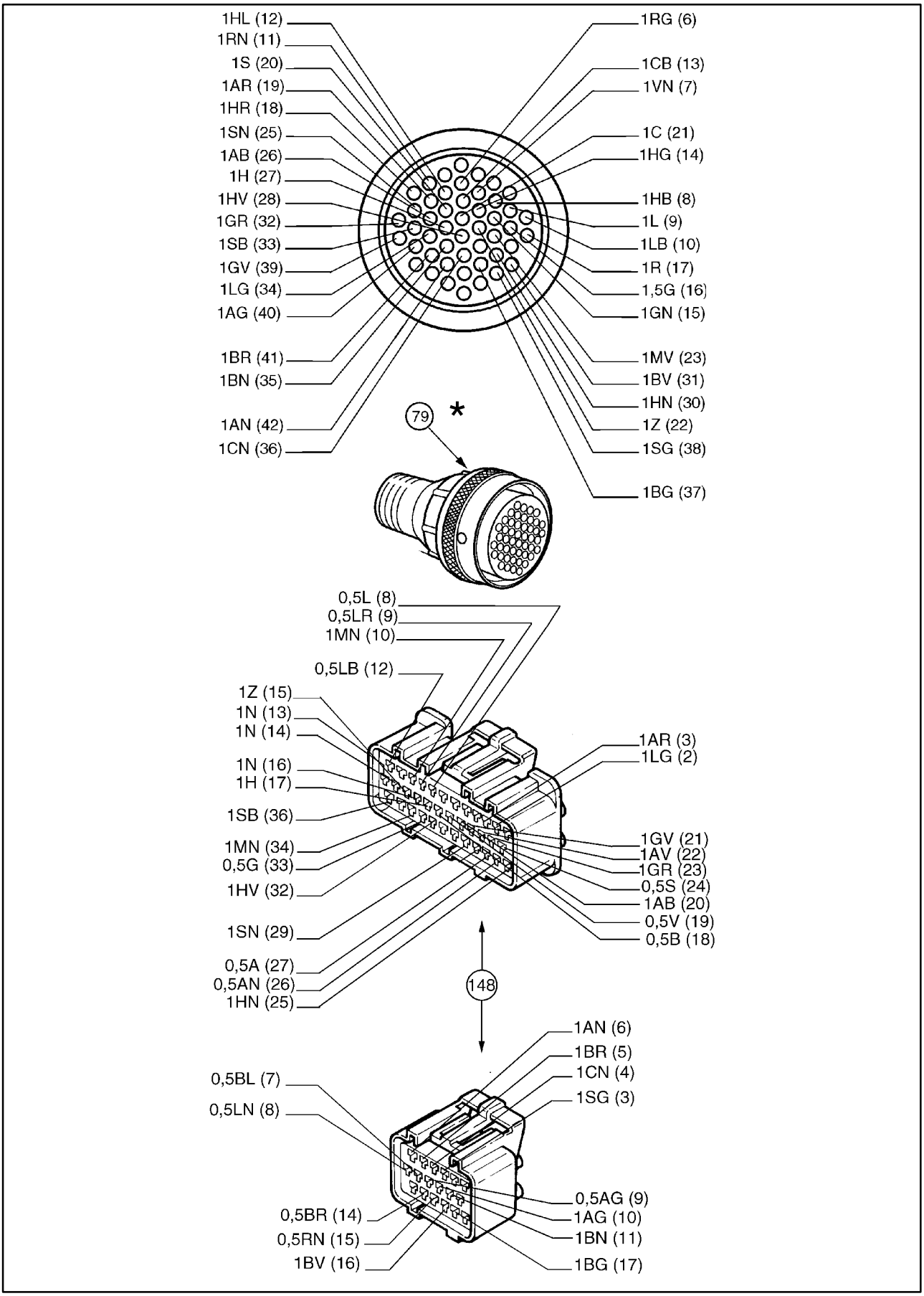
Check the wiring between pin 38 on connection (79) and pin CN1-3 on connections (148). Eliminate any interruptions or short circuits to ground. Does the fault persist?

YES

Replace the ECU.

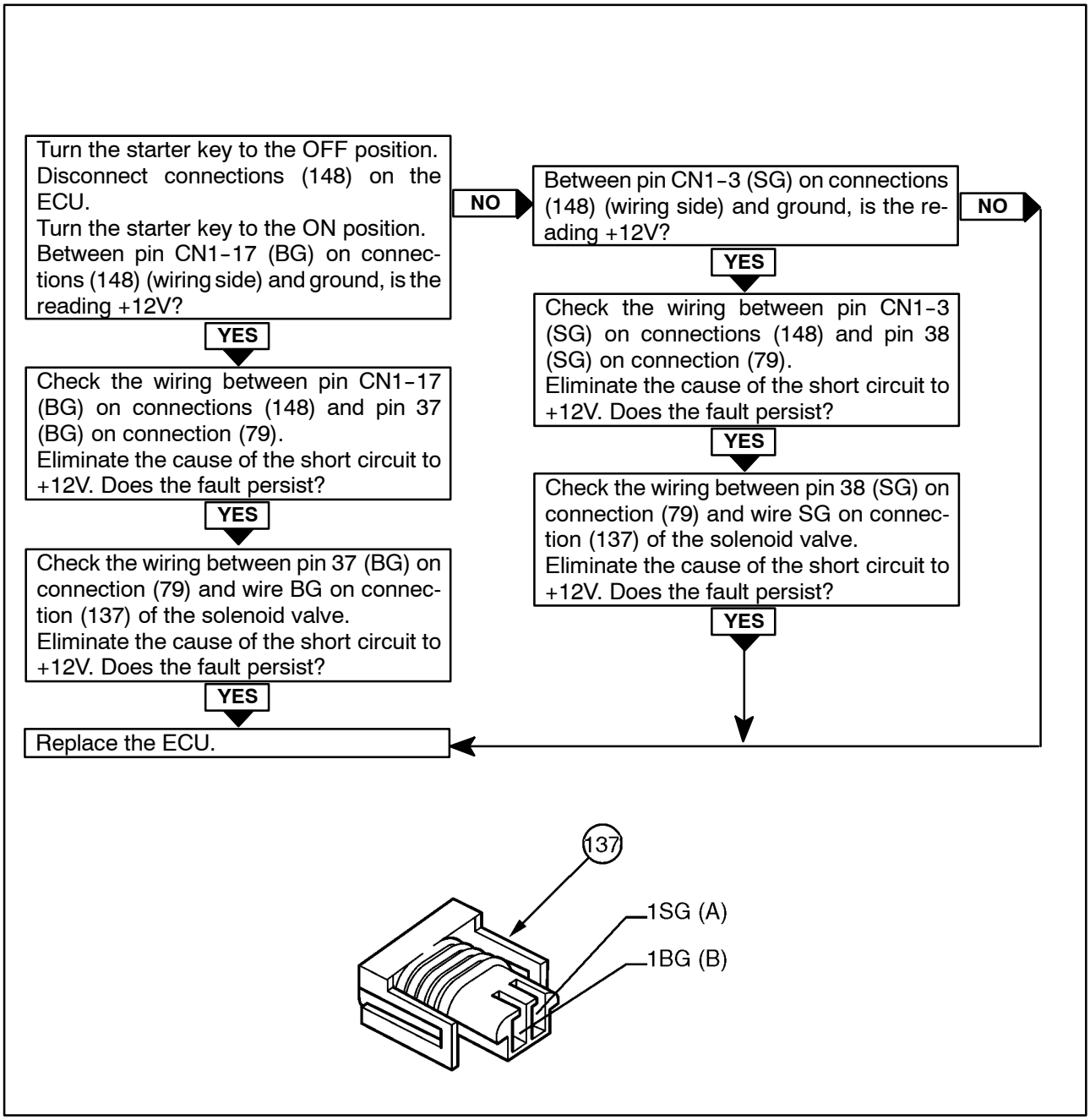


FAULT CODE 66

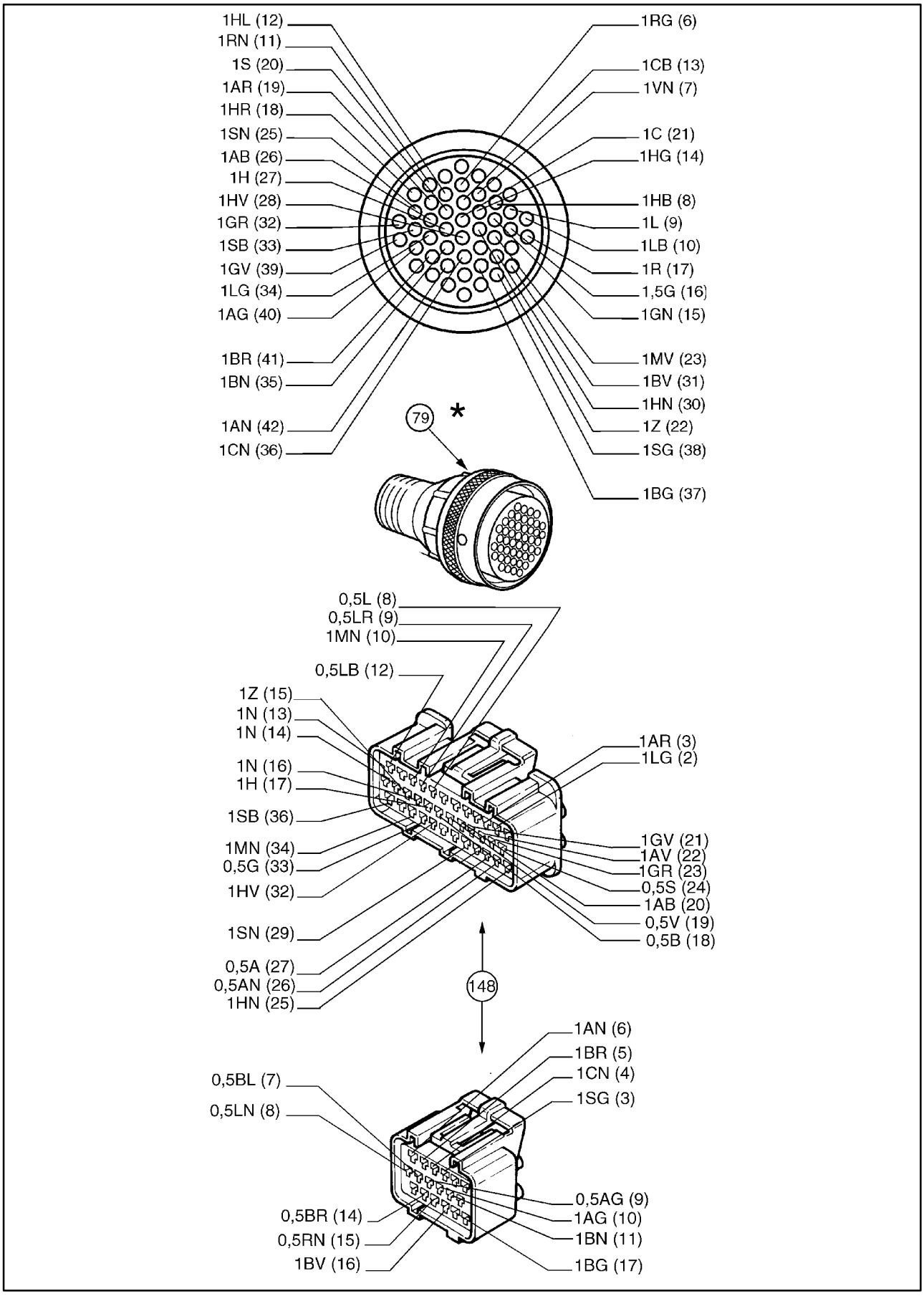


FAULT CODE 67

The wiring on solenoid valve (10, page 10) of clutch (D) (8, page 8) is in short to +12V or the ECU is faulty.
The tractor is not operative.

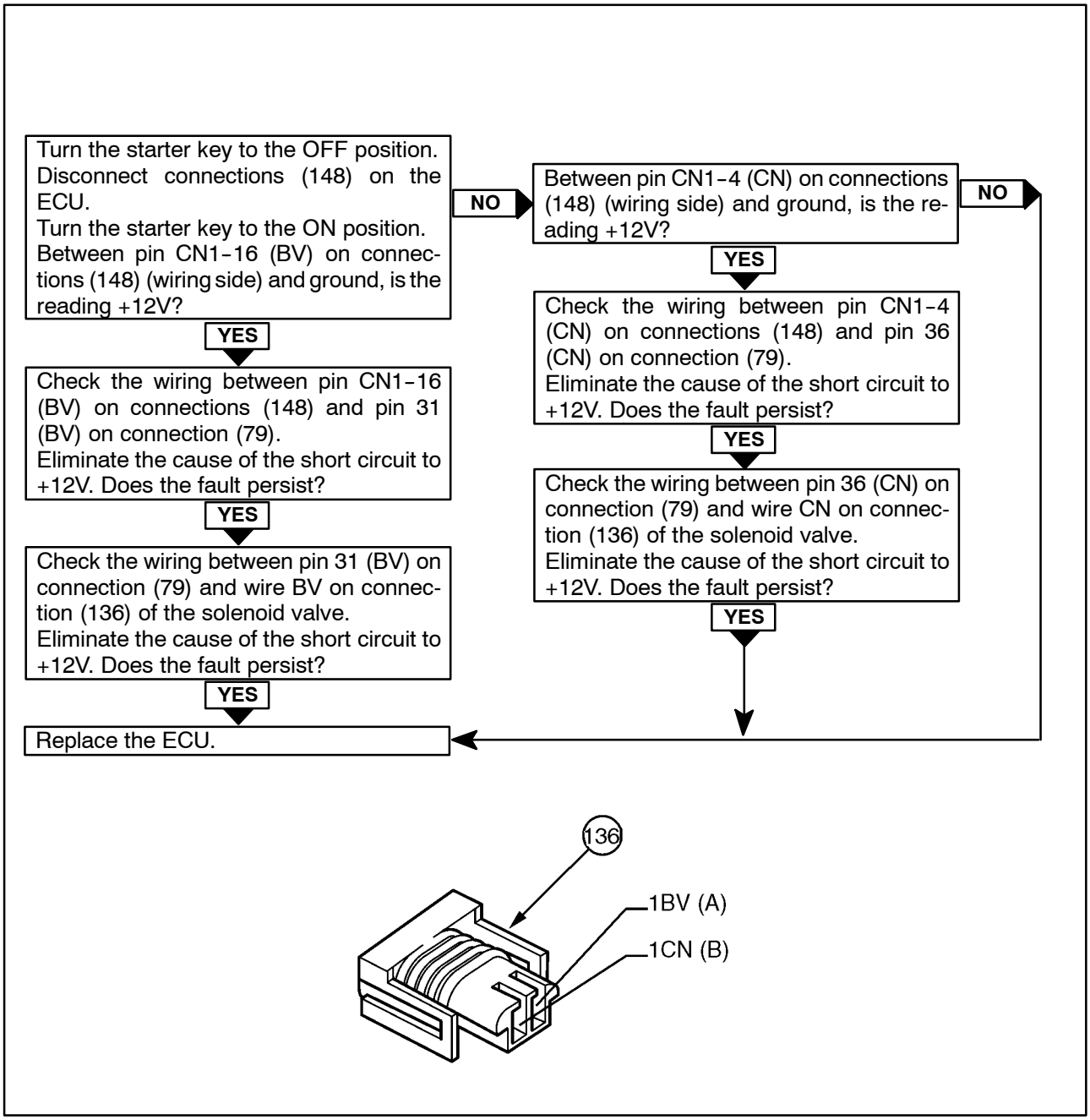


FAULT CODE 67

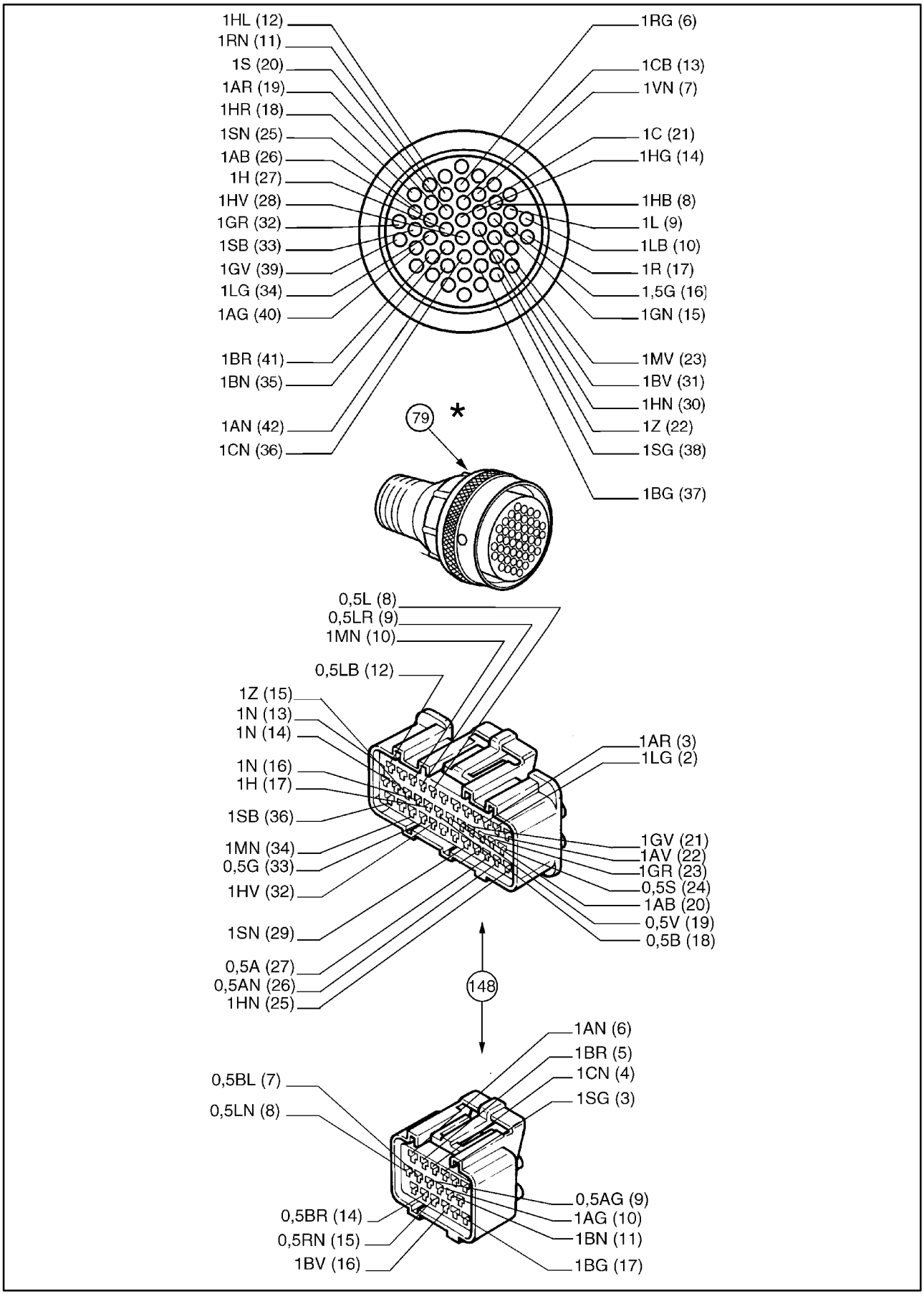


FAULT CODE 68

The wiring on solenoid valve (11, page 10) of clutch (C) (7, page 8) is in short to +12V or the ECU is faulty.
The tractor is not operative.



FAULT CODE 68



FAULT CODE 69

The wiring on tractor speed sensor (Y) is in short circuit to ground.

The tractor runs but may function irregularly.

Turn the starter key to the OFF position. Disconnect the speed sensor connection (142) by removing the rear left-hand wheel. Is pin (SB) (wiring side) in short circuit to ground?

NO → Check and replace the sensor if necessary.

YES

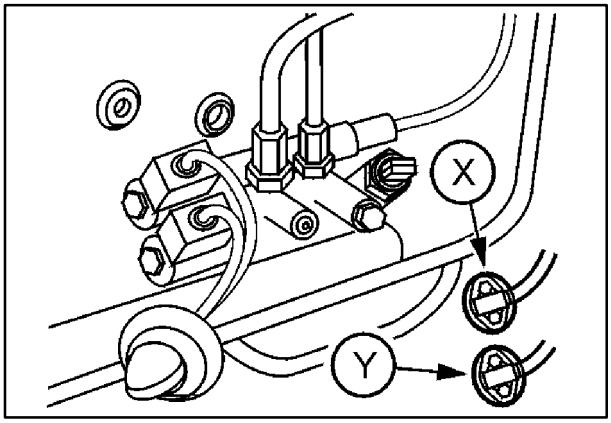
Check the wiring between pin (SB) on the sensor wiring and pin 33 (SB) on connection (79). Eliminate the cause of the short circuit to ground. Does the fault persist?

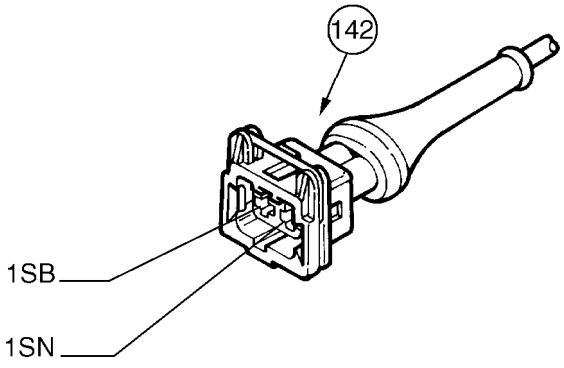
YES

Check the wiring between pin 33 (SB) on connection (79) and pin CN2-36 (SB) on connections (148). Eliminate the cause of the short circuit to ground. Does the fault persist?

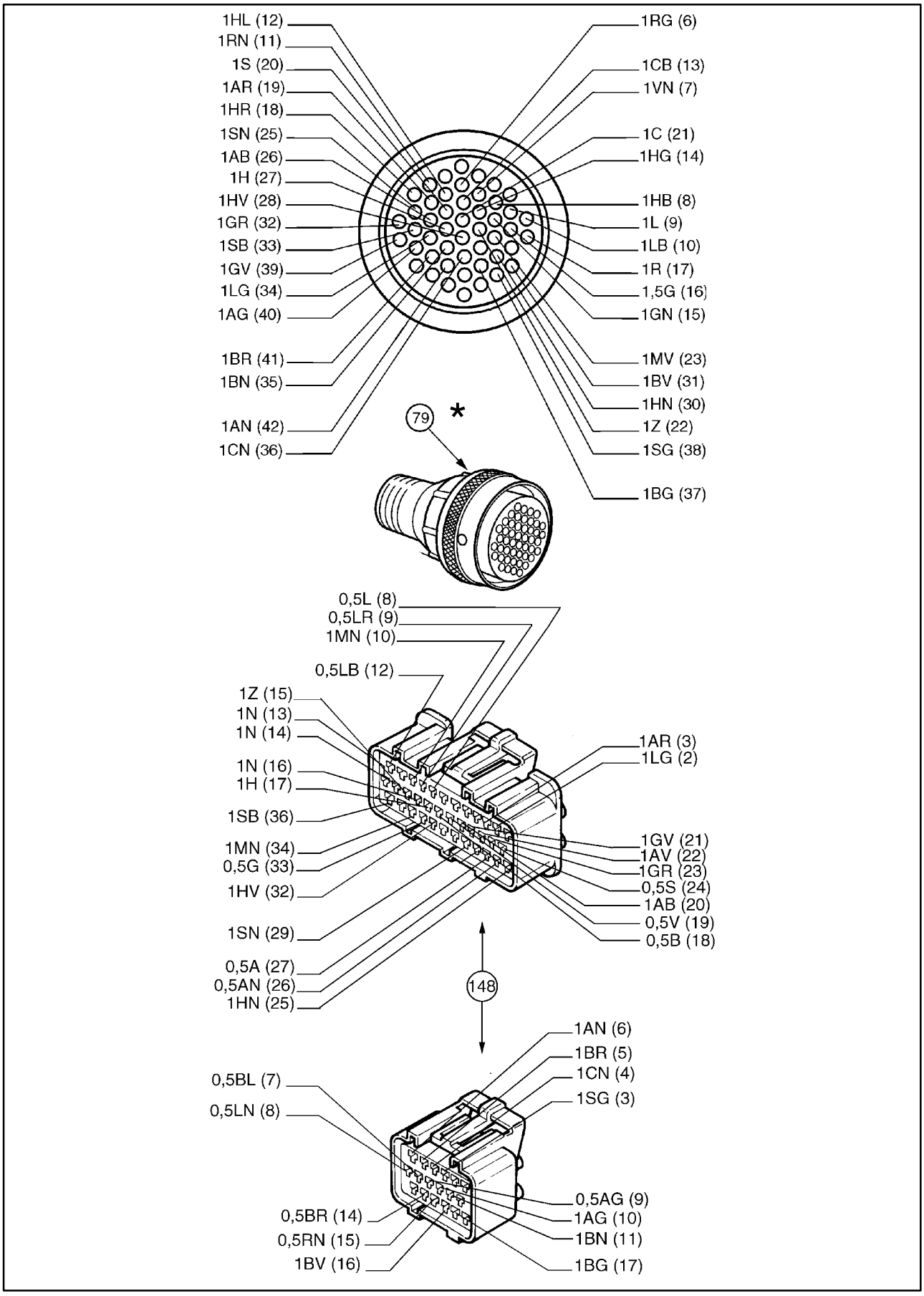
YES

Replace the ECU





FAULT CODE 69



FAULT CODE 73

The supply voltage on the ECU exceeds +18V.

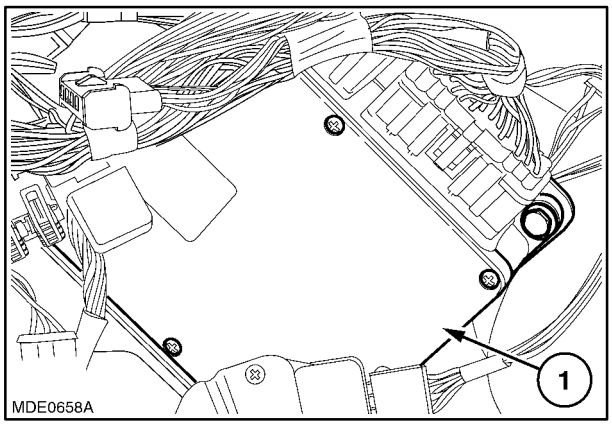
The tractor is not operative.

Turn the starter key to the OFF position.
Start the engine and accelerate to 1200 rpm.
Using a digital tester, measure the battery voltage.
Is the voltage ~ 14V?

NO → Check the recharging system and replace the alternator if the voltage is much higher than +14 V.

YES

Replace the ECU (2).



FAULT CODE 74

The supply voltage on the ECU is less than +9V.

The tractor is not operative.

Turn the starter key to the OFF position.
Remove the left-hand panel located under the dashboard.
Is fuse F1 (10A), (Section 55, Chapter 6, pages 7 to 13) faulty?

NO → Replace fuse.

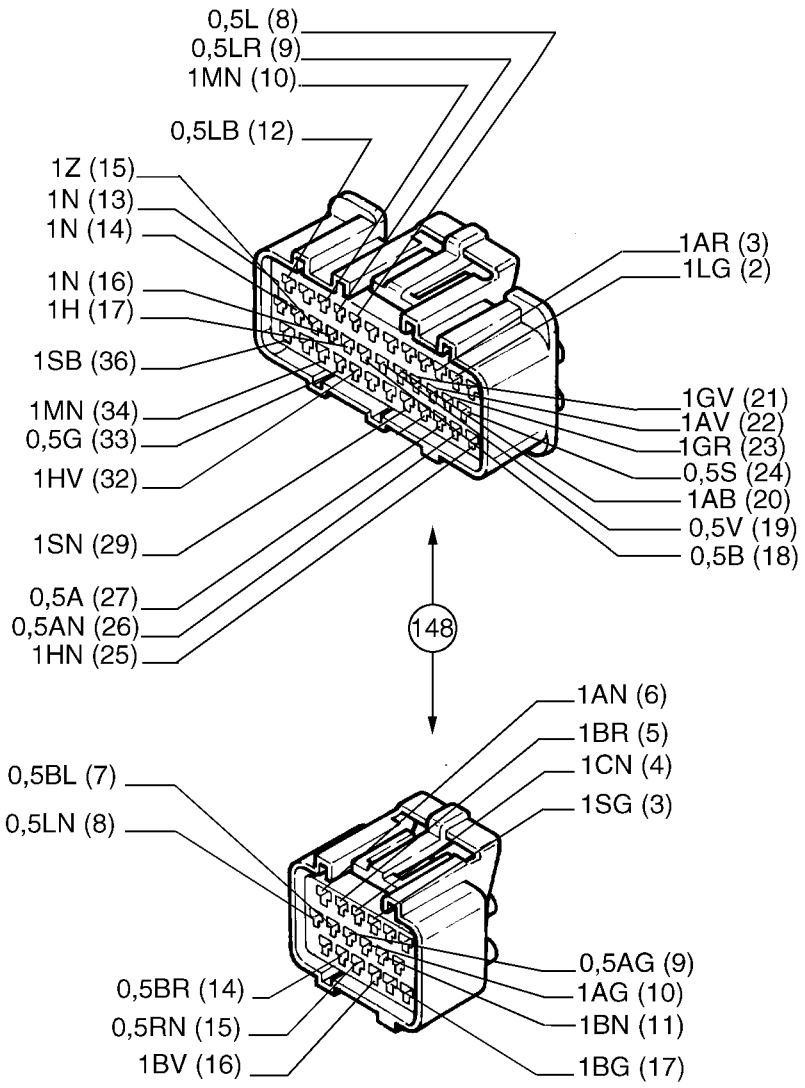
YES

Disconnect connections (148) on the ECU. Turn the starter key to the ON position.
Between pins CN2-10 (MN) and CN2-34 (MN) on connections (148) and ground, is the reading +12V?

NO → Check the wiring between pins CN2-10 (MN) and CN2-34 (MN) on connections (148) and the fuse box and eliminate the cause of the open circuit.

YES

Replace the ECU.

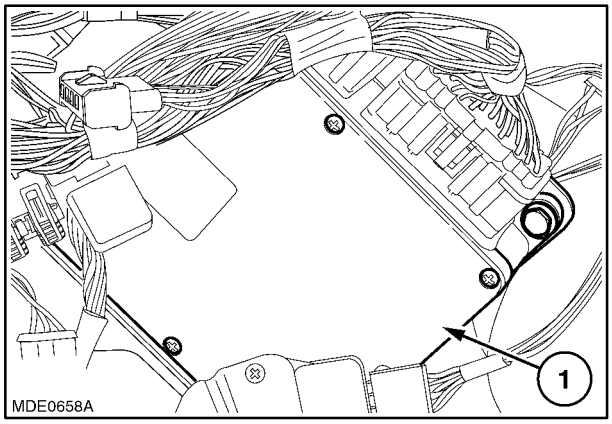


FAULT CODE 76

The ECU memory does not contain stored calibration values.

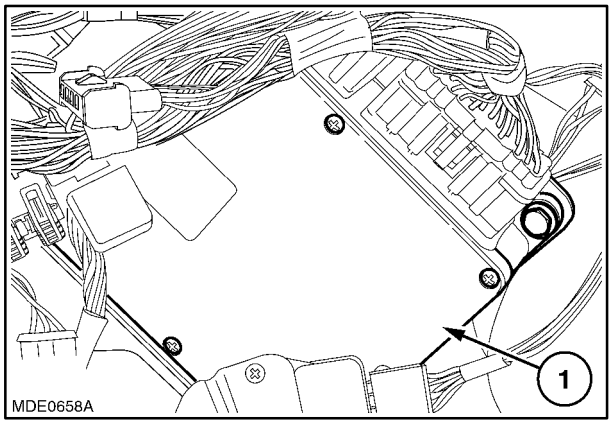
The tractor runs but may function irregularly.

Replace the ECU (1).



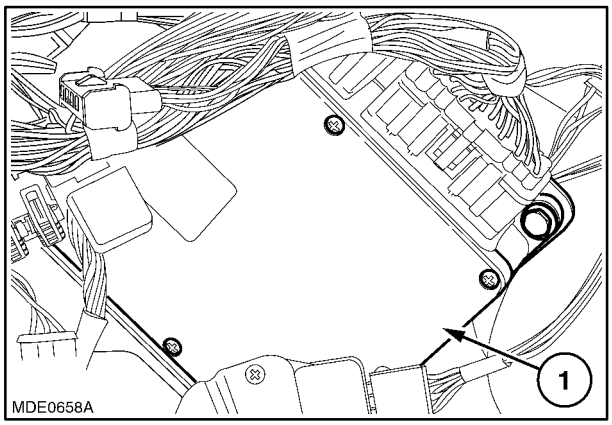
FAULT CODE 77

The 8 volt power supply at the ECU is too high. The ECU is faulty and must be replaced.
The tractor is not operative.



FAULT CODE 78

The 8 volt power supply at the ECU is too low. The ECU is faulty and must be replaced.
The tractor is not operative.

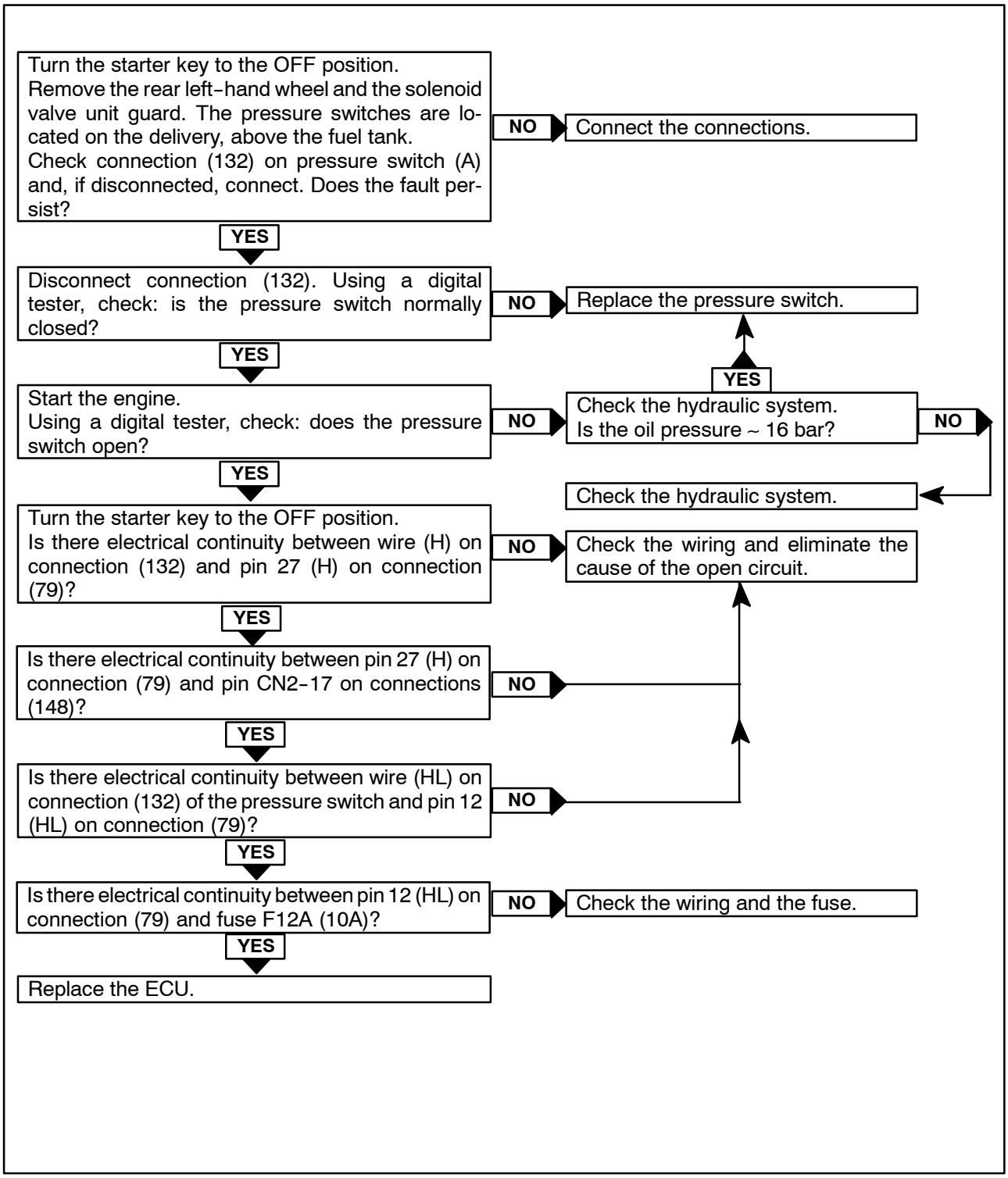


FAULT CODE 81

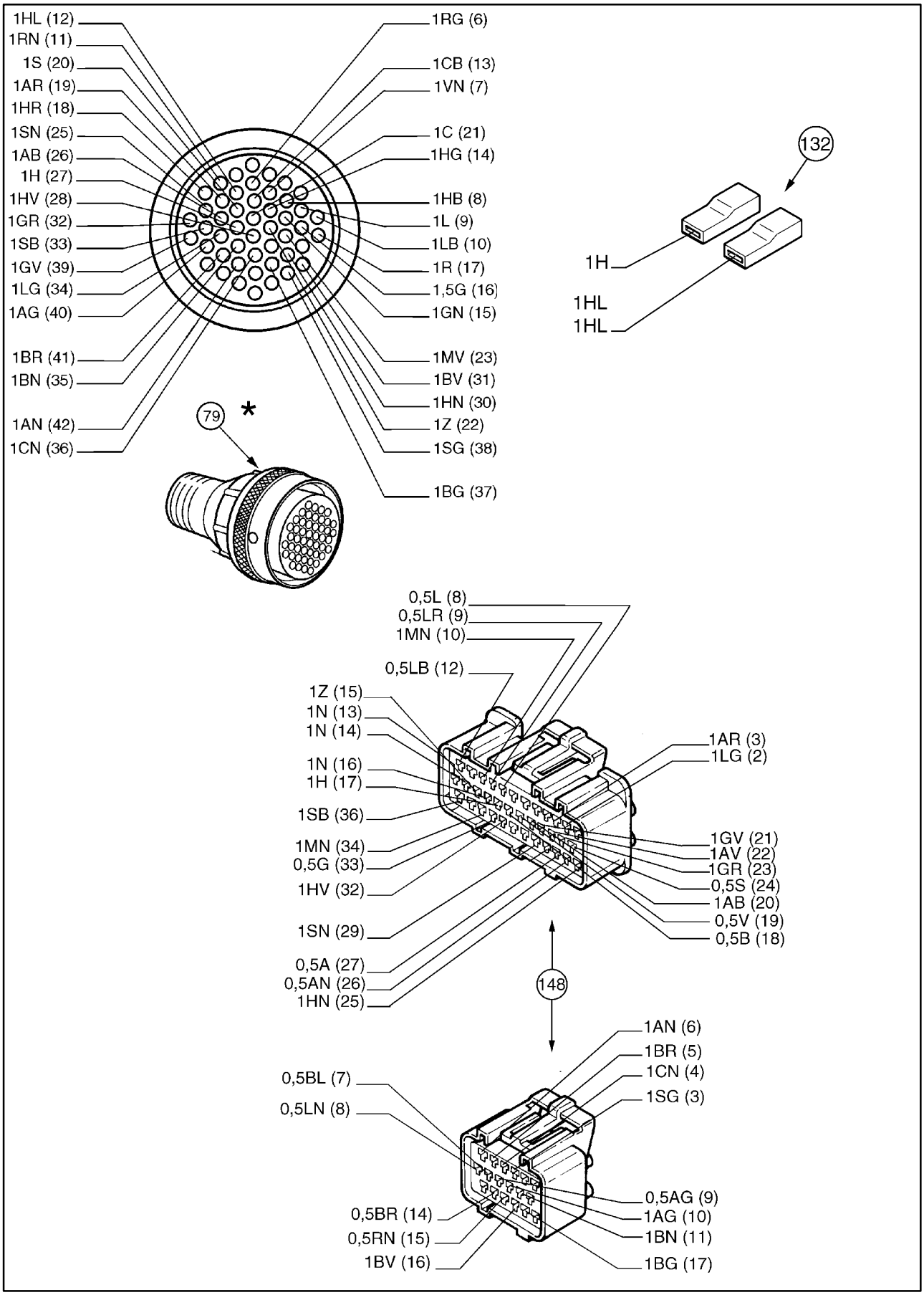
Safety pressure switch A is interrupted or in short circuit to ground.

The wiring on the oil pressure switch for clutch (A) is in short circuit or the pressure switch is faulty. During starting, when the clutch oil reaches the pressure switch at a pressure of >159.54 psi (> 11 bar), a signal is sent to the ECU, allowing the clutches to be engaged.

The tractor no longer provides pressure data to the control unit: it can be used by means of the clutch pedal but the Power Shuttle lever is disabled.



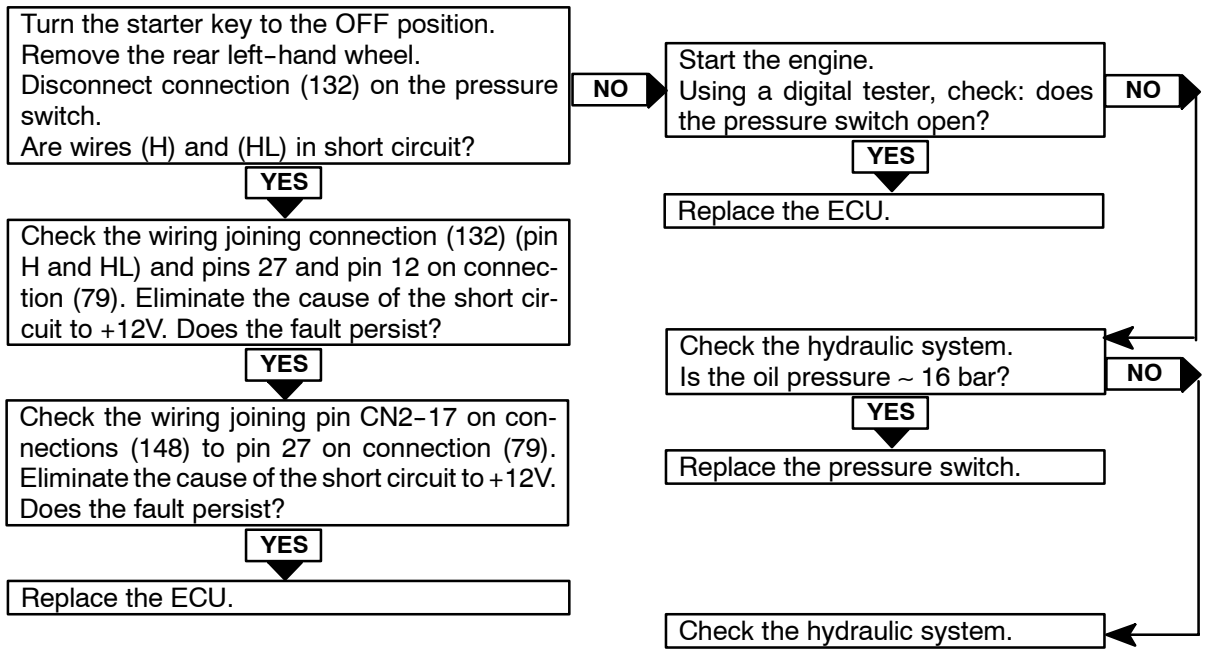
FAULT CODE 81

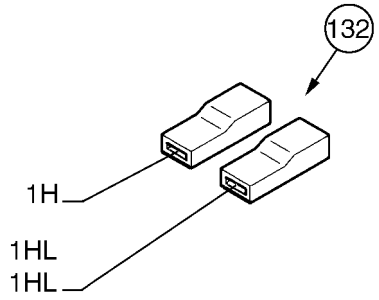


FAULT CODE 82

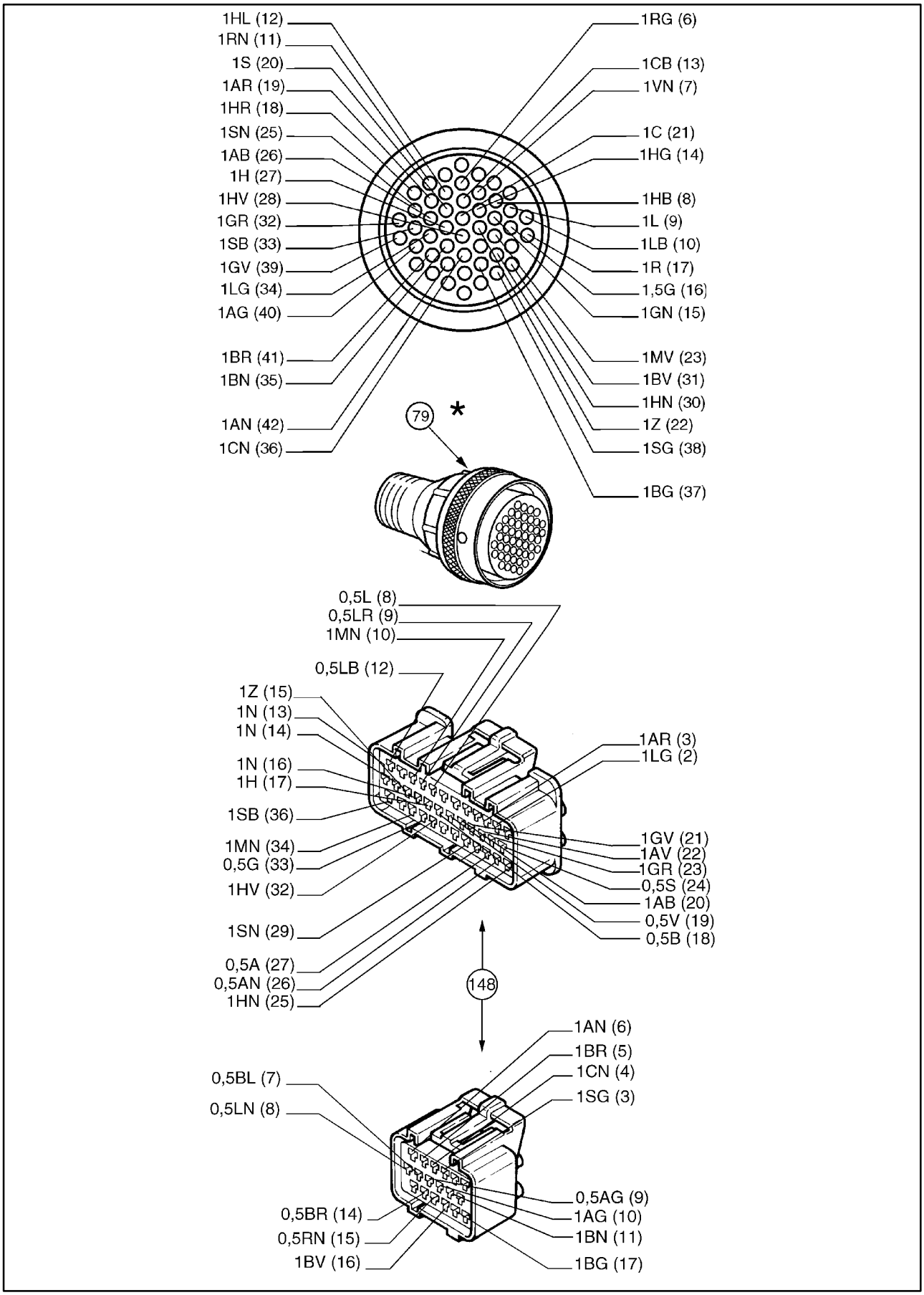
The wiring on the oil pressure switch of clutch (A) is in short circuit or the pressure switch is faulty

During starting, when the clutch oil reaches the pressure switch at a pressure of >159.54 psi (> 11 bar), a signal is sent to the ECU, allowing the clutches to be engaged.
The tractor no longer provides pressure data to the control unit: it can be used by means of the clutch pedal but the Power Shuttle lever is disabled.





FAULT CODE 82

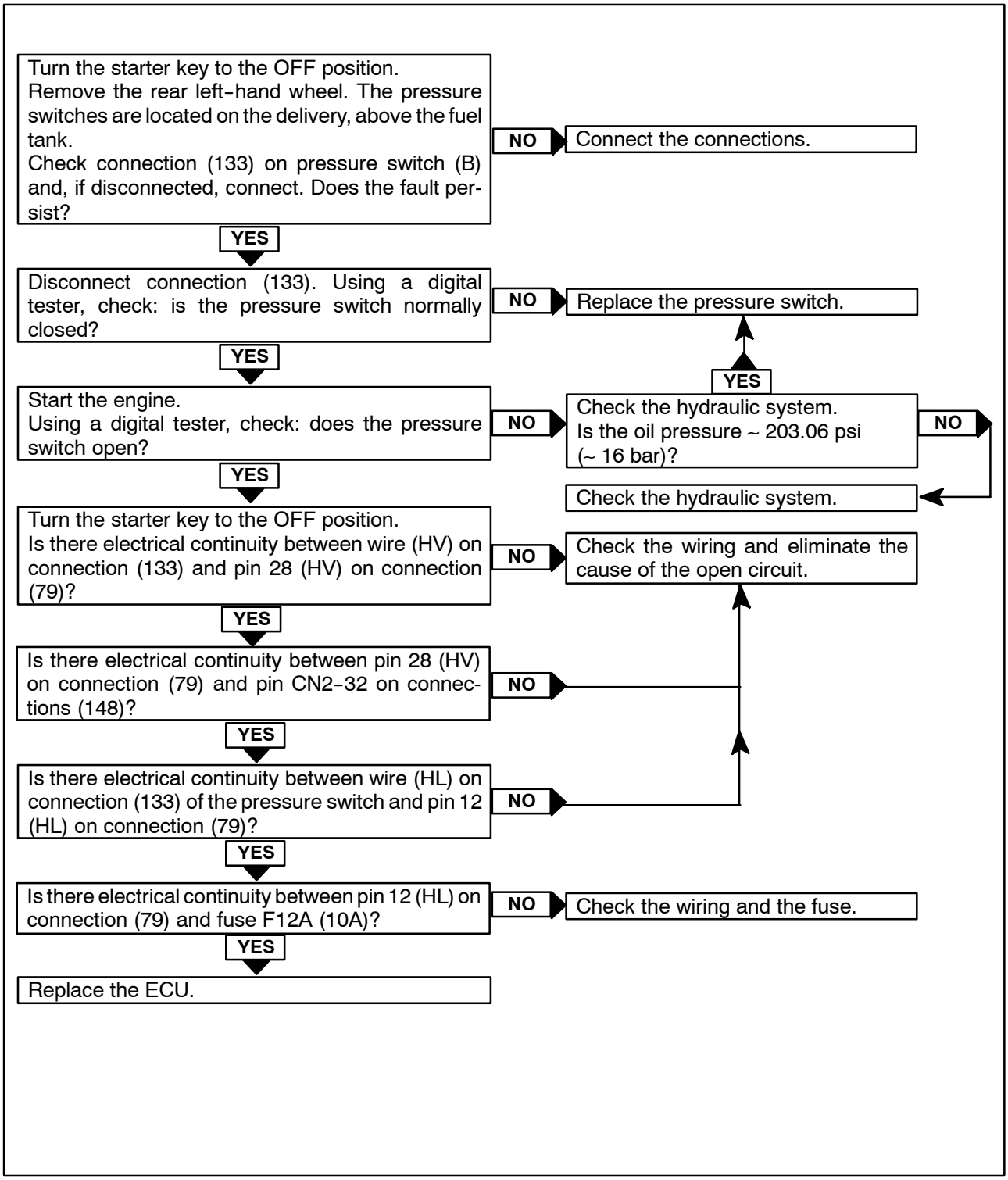


FAULT CODE 83

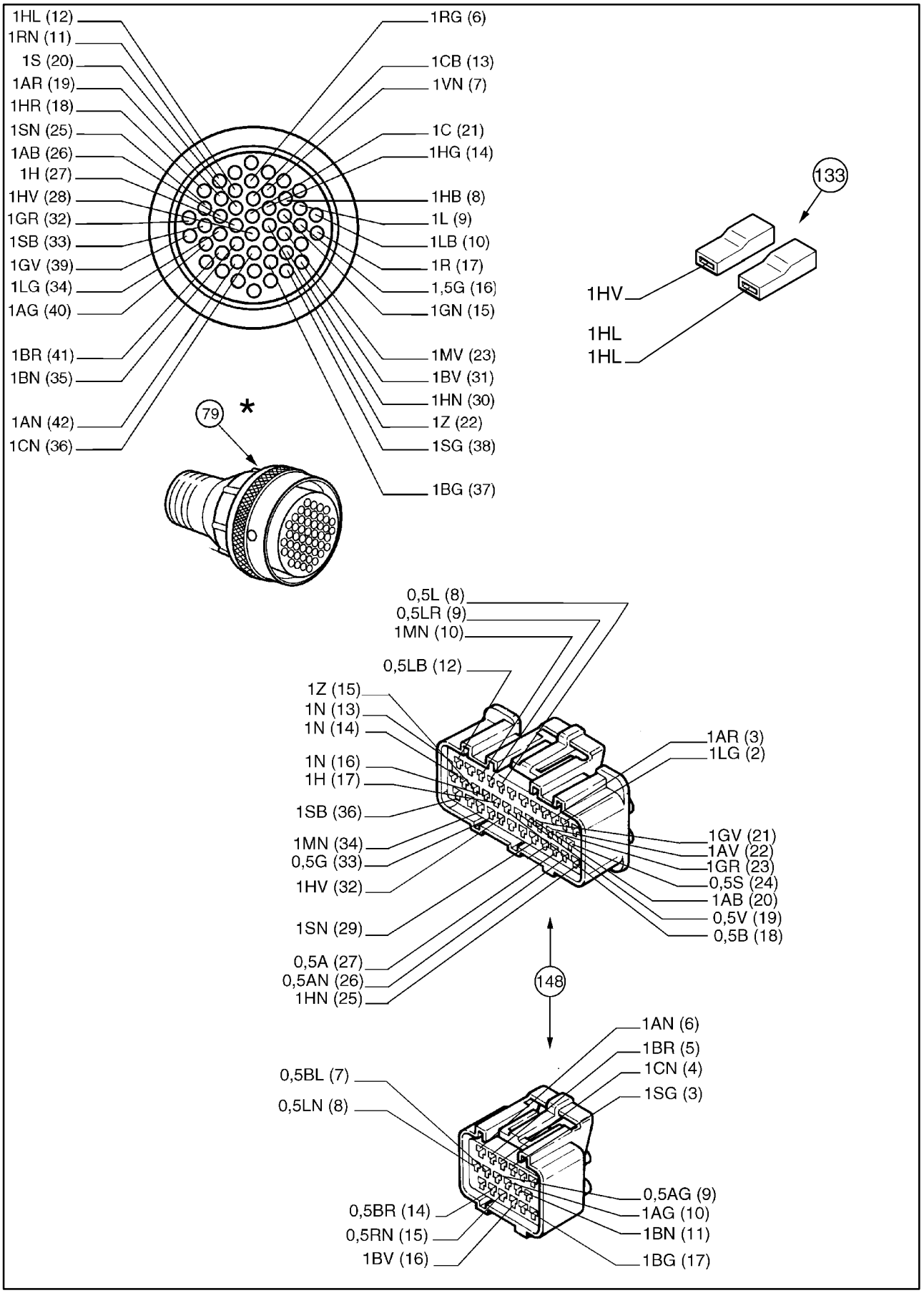
Safety pressure switch B is interrupted or in short circuit to ground.

The wiring on the oil pressure switch for clutch (B) is in short circuit or the pressure switch is faulty. During starting, when the clutch oil reaches the pressure switch at a pressure of >159.54 psi (> 11 bar), a signal is sent to the ECU, allowing the clutches to be engaged.

The tractor no longer provides pressure data to the control unit: it can be used by means of the clutch pedal but the Power Shuttle lever is disabled.



FAULT CODE 83



FAULT CODE 84

The wiring on the oil pressure switch of clutch (B) is in short circuit or the pressure switch is faulty

During starting, when the clutch oil reaches the pressure switch at a pressure of >159.54 psi (> 11 bar), a signal is sent to the ECU, allowing the clutches to be engaged.
The tractor no longer provides pressure data to the control unit: it can be used by means of the clutch pedal but the Power Shuttle lever is disabled.

Turn the starter key to the OFF position.
Remove the rear left-hand wheel.
Disconnect connections (133) on the pressure switch.
Are wires (HV) and (HL) in short circuit?

NO → Start the engine.
Using a digital tester, check: does the pressure switch open?

NO → Check the hydraulic system.
Is the oil pressure ~ 203.06 psi (~ 16 bar)?

NO → Check the hydraulic system.

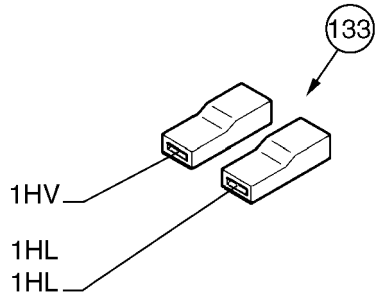
YES → Replace the pressure switch.

YES → Replace the ECU.

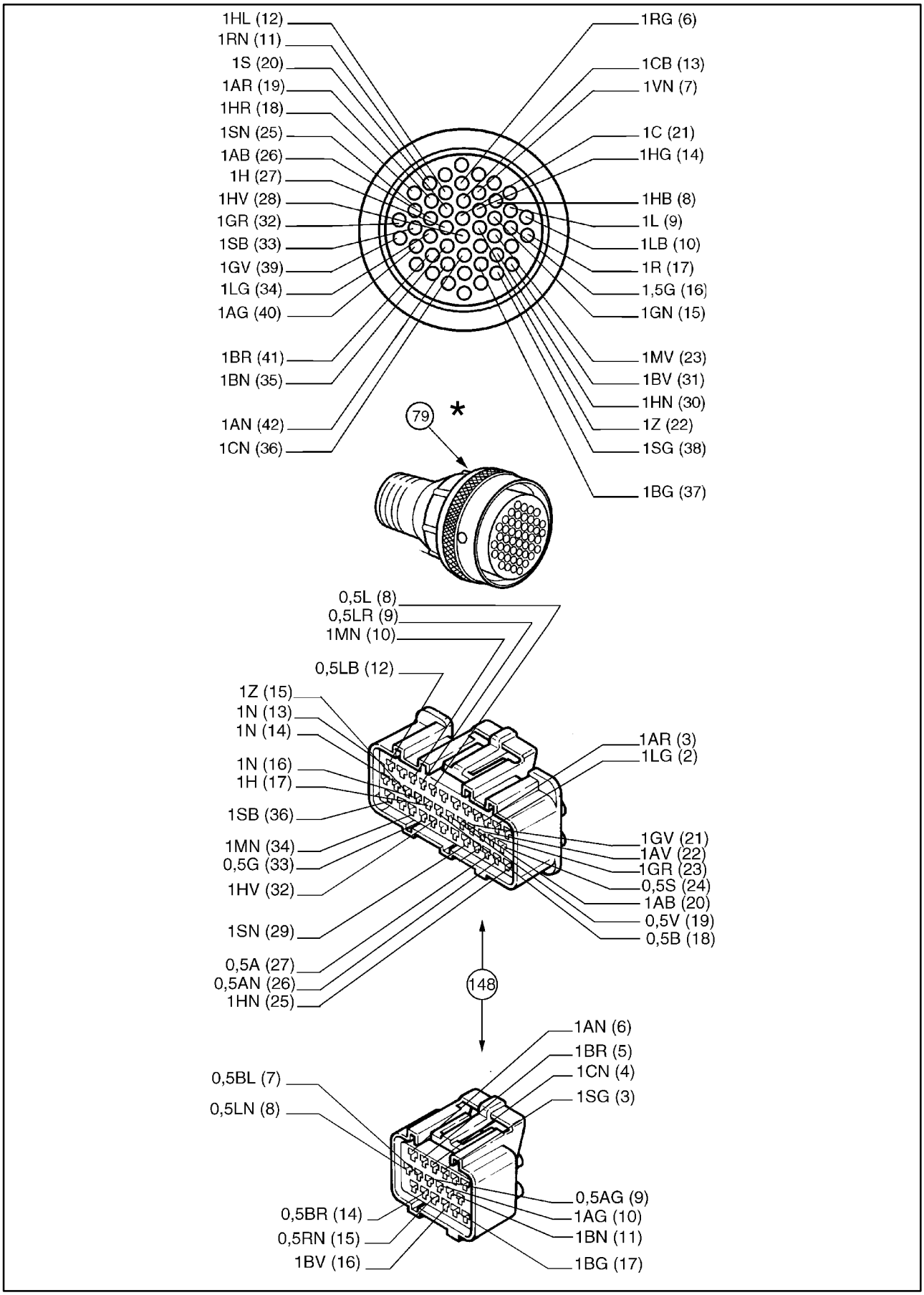
YES → Check the wiring joining connection (133) (pin HV and HL) and pins 28 and pin 12 on connection (79). Eliminate the cause of the short circuit to +12V. Does the fault persist?

YES → Check the wiring joining pin CN2-32 on connections (148) to pin 28 on connection (79). Eliminate the cause of the short circuit to +12V. Does the fault persist?

YES → Replace the ECU.



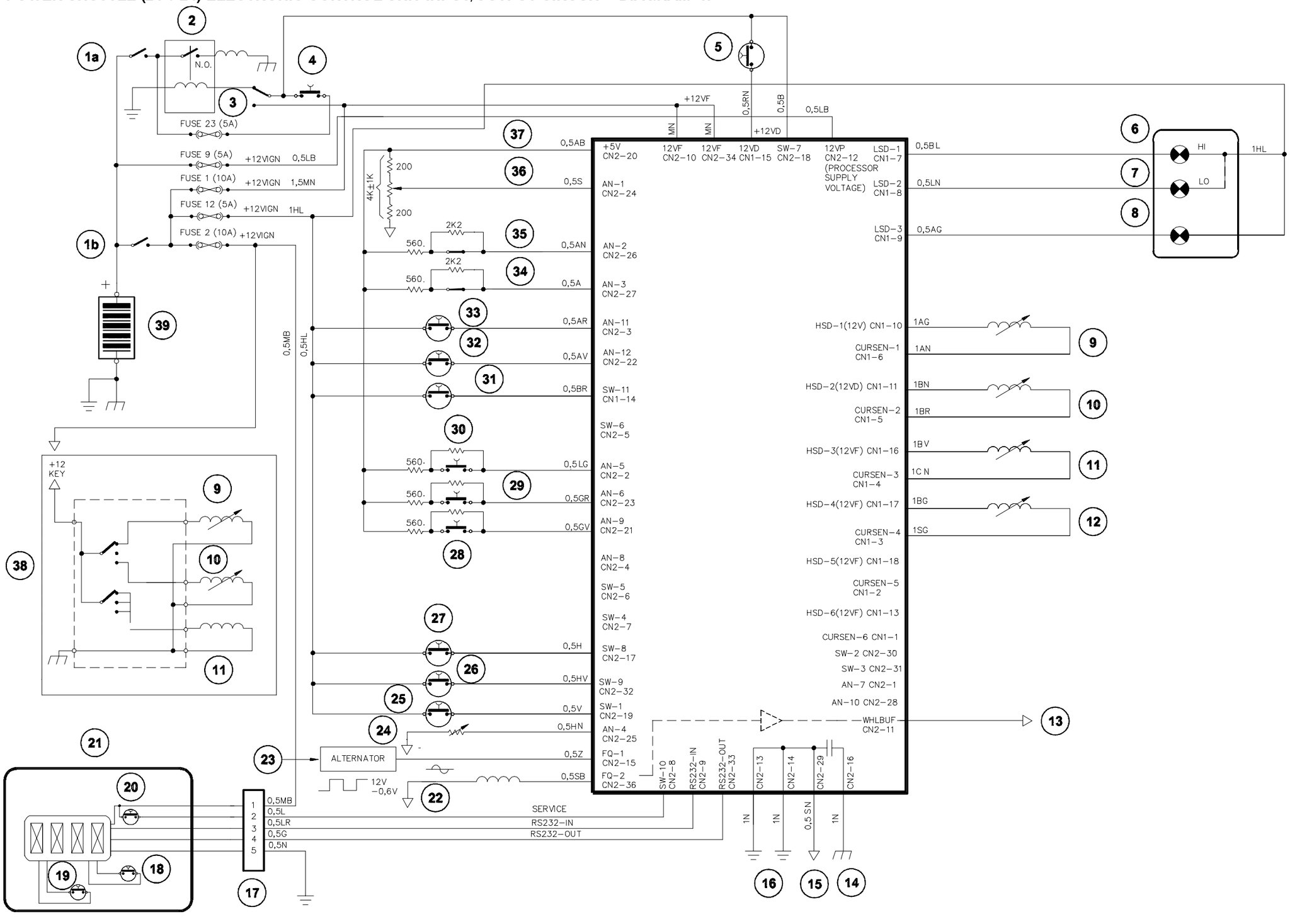
FAULT CODE 84



POWER SHUTTLE (24 + 24)
ELECTRONIC CONTROL UNIT INPUT/OUTPUT CIRCUIT
(Diagram W)

1 Start switch. 1a: starter function - 1b. gear function
2 Starter relay
3 Shuttle control lever
4 Clutch control pedal switch
5 Clutch control pedal switch
6 HIGH speed ON indicator signal
7 LOW speed ON indicator signal
8 Transmission alarm indicator light
9 Clutch A (forward gears) solenoid valve
10 Clutch B (forward gears) solenoid valve (reverse gears)
11 Clutch C control solenoid valve
12 Clutch D control solenoid valve
13 Speed sensor amplified signal
14 Bodywork ground
15 Sensors ground
16 Power ground
17 Connection for Troubleshooting unit **294084**
18 Push-button ▲
19 Push-button ▼
20 HMENU selection push-button
21 Troubleshooting unit **294084**
22 Speed sensor
23 Engine revs counter (alternator)
24 Transmission oil temperature sensor
25 Driving seat safety switch
26 Safety pressure switch B
27 Safety pressure switch A
28 Range status sensor switch (R2)
29 Range status sensor switch (R1)
30 Gear status sensor switch (G1)
31 Parking brake ON switch
32 LOW speed control push-button
33 HIGH speed control push-button
34 Shuttle lever in reverse gear selection position
35 Shuttle lever in forward gear selection position
36 Clutch pedal potentiometer signal
37 Sensor power supply (+5V)
38 Emergency cable for “limp home” after electrics breakdown
39 Battery

POWER SHUTTLE (24 + 24) ELECTRONIC CONTROL UNIT INPUT/OUTPUT CIRCUIT - DIAGRAM W



MPD3139A

SECTION 23 - DRIVE LINES

Chapter 1 - Drive lines

CONTENTS

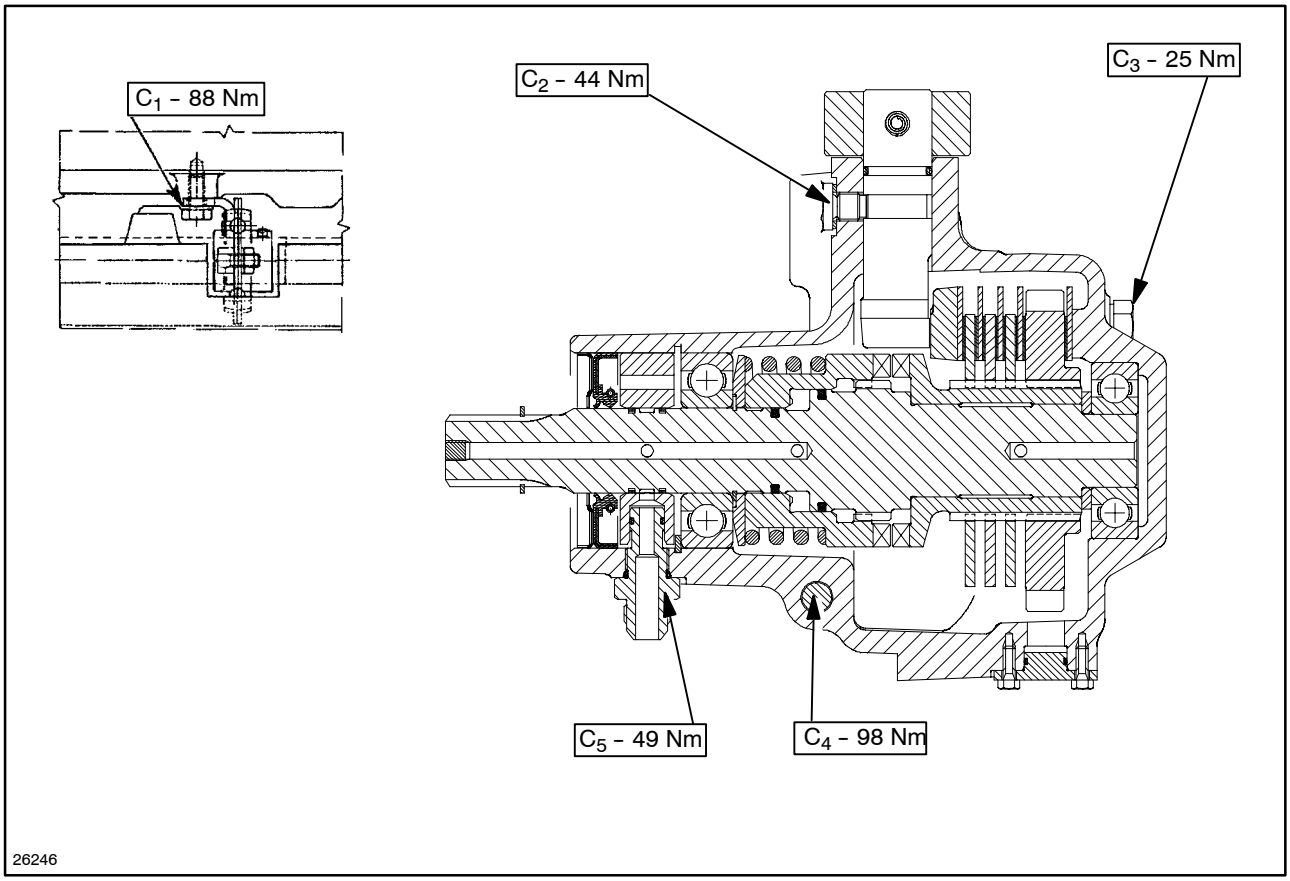
Operation	Description	Page
	Data	2
	Tightening Torques	3
	Tools	3
	Cross-sectional views	4
	Description of operation and hydraulic diagrams	5
	Fault diagnosis	6
23 202 20	Services control valve R.I.	7
23 202 24	Services control valve D.A.	10
23 202 50	Drive gear housing R.I.	12
23 202 52	Drive gear housing D.A.	17

MAIN SPECIFICATIONS - ELECTRO-HYDRAULICALLY ENGAGED 4WD

Reduction ratio of drive gear device (on all models)		34/34 = 1:1
Number of mobile friction sections (14, fig. 3) (one-sided)		2
Number of mobile friction sections (14) (two-sided)		3
Number of brake disks (12)		3
Brake control lever pin diameter (16)	in. (mm)	1.1015 to 1.1023 (27.979 to 28.000)
Brake control lever pin seat diameter on casing (29)	in. (mm)	1.1031 to 1.1044 (28.020 to 28.053)
Clearance between pin (16) and seat on casing (29)	in. (mm)	0.0007 to 0.0029 (0.020 to 0.074)
Internal diameter of sliding sleeve (19)	in. (mm)	1.3811 to 1.3826 (35.080 to 35.119)
Diameter of coupled shaft (1)	in. (mm)	1.3780 to 1.3790 (35.002 to 35.027)
Internal diameter of sliding sleeve (19)	in. (mm)	1.9716 to 1.9728 (50.080 to 50.119)
Diameter of coupled shaft (1)	in. (mm)	1.9675 to 1.9685 (49.975 to 50.000)
Internal diameter of fixed sleeve (8)	in. (mm)	1.4980 to 1.4995 (38.050 to 38.089)
Diameter of coupled shaft (1)	in. (mm)	1.4931 to 1.4940 (37.925 to 37.950)
Length of spring (7, with spring free)	in. (mm)	3.2283 (82)
Spring length (7) under load of 133.38 to 144.40 lb (60.5 to 65.5 kg)	in. (mm)	1.5748 (40)
Mobile friction section (14, one-sided)	in. (mm)	0.1220 to 1.1338 (3.1 to 3.4)
Mobile friction section (14, two-sided)	in. (mm)	0.1653 to 0.1771 (4.2 to 4.5)
Brake driven disk (12)	in. (mm)	0.1555 to 0.1594 (3.95 to 4.05)

PROPELLER SHAFT DATA

Thickness of rings (32, fig 3) that adjust the position of the front sleeve (31) on the 4WD propeller shaft	in. (mm)	0.0590 - 0.0748 - 0.0866 - 0.0984 - 0.01102 - 0.1181 - 0.1299 - 0.1456 - 0.1574 - 0.1692 (1.5 - 1.9 - 2.2 - 2.5 - 2.8 - 3 - 3.3 - 3.7 - 4 - 4.3)
Front sleeve end float (L)	in. (mm)	0.0393 to 0.0590 (1.0 to 1.5)



1

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Propeller shaft central support retaining bolt (C_1)	M 12 x 1.5	88	9
Parking brake control lever axial retaining bolt (C_2)	M 12 x 1.25	44	4.5
Screw with guide pin for brake disk braking sectors (C_3)	M 12 x 1.25	25	2.5
Drive gear housing retaining bolt (C_4)	M 12 x 1.25	98	10
Control cylinder oil delivery union (C_5)	M 18 x 1.50	49	5

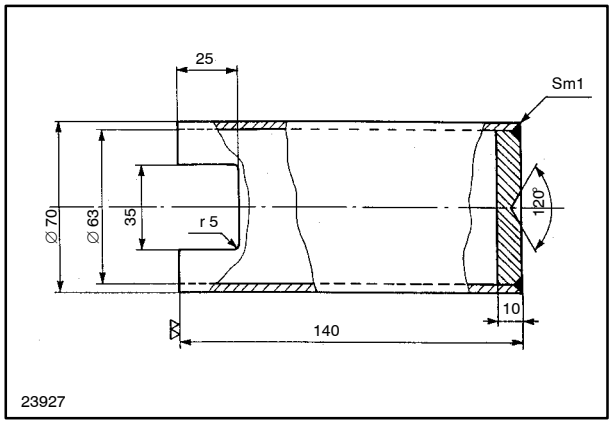
TOOLS

WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

380000279 Guard for driving shaft seal assembly ∅ 50.

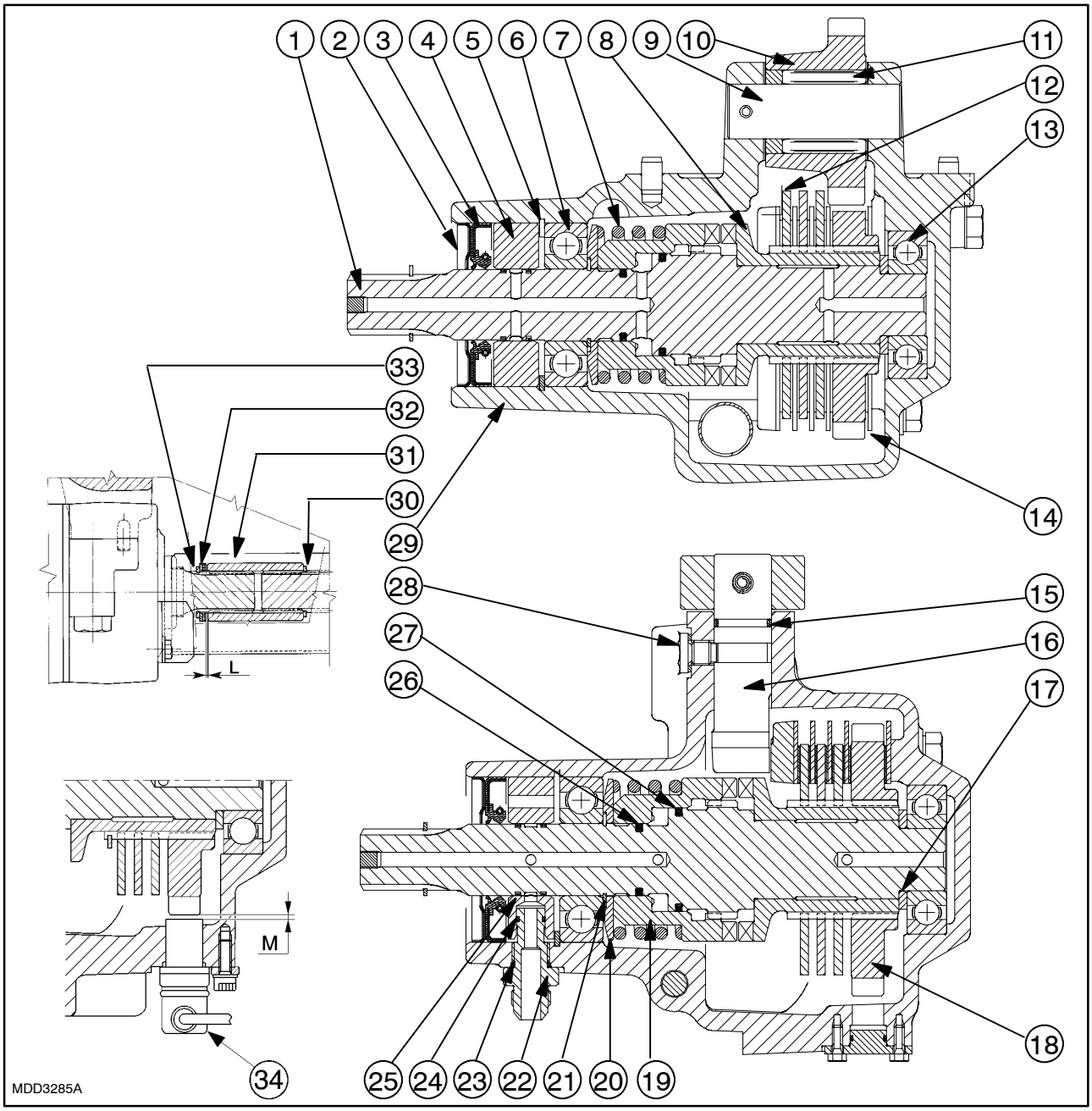
380000280 Guard for driving shaft seal assembly ∅ 35.



2

Punch to make for drive gear uncoupling spring disassembly-assembly. (Mark tool with no. 50107). - (Dimensions in mm)

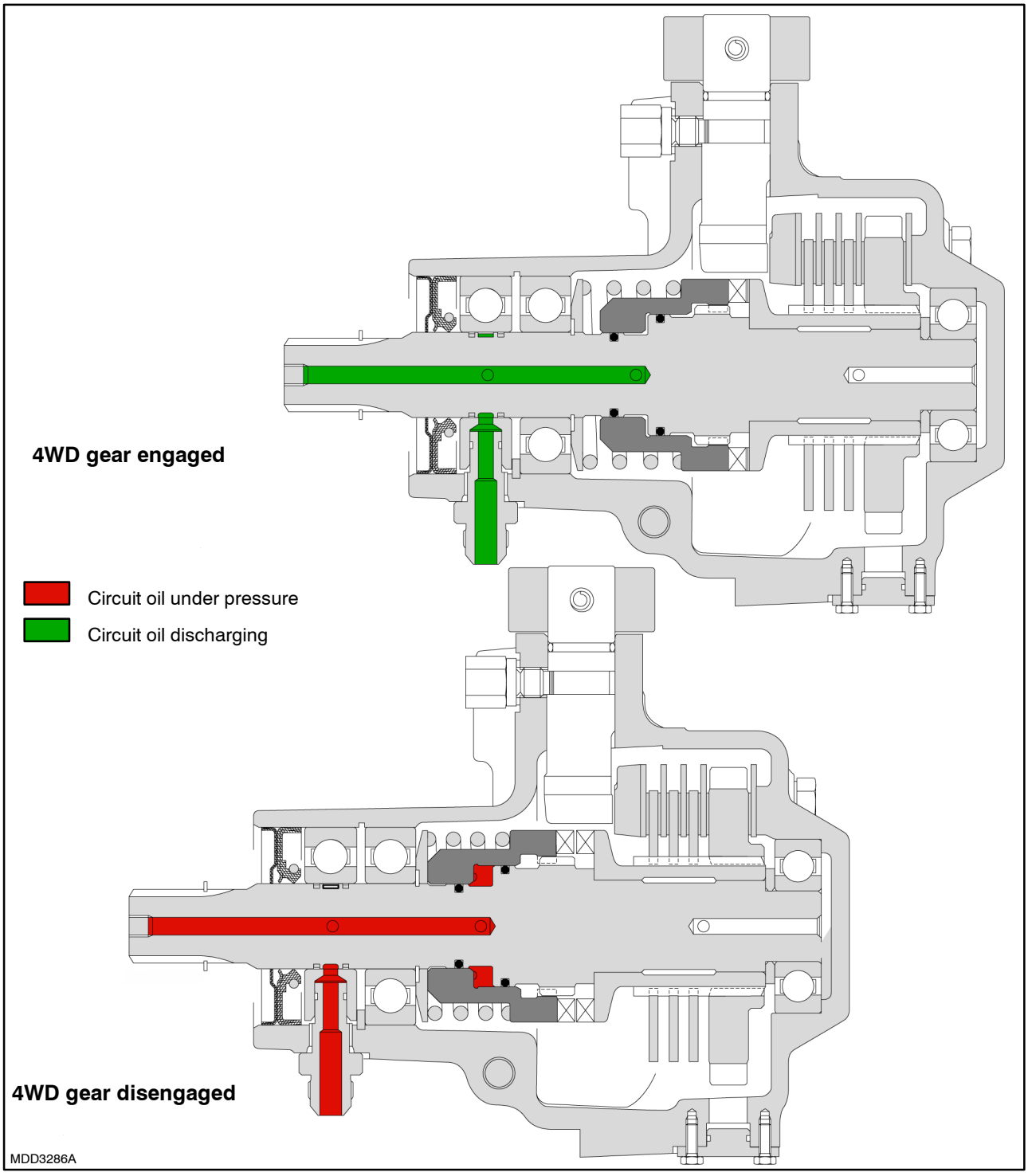
NOTE: *Make the tool in F42 material.*



3

Sectional view of drive gear with electrohydraulic coupling

1. Driven Shaft.
2. Dust ring.
3. Seal.
4. Manifold ring.
5. Circlip.
6. Ball bearing.
7. 4WD engagement spring.
8. Fixed engagement.
9. Intermediate gear journal.
10. Intermediate gear.
11. Needle bearing.
12. Parking brake disks.
13. Ball bearing.
14. Braking sectors.
15. O-ring seal.
16. Parking brake control lever.
17. Thrust washer.
18. Driven gear.
19. Mobile coupling.
20. Plate.
21. Circlip.
22. Control cylinder oil delivery union.
23. **24.**O-ring seals.
25. Metal seal rings
26. **27.**O-ring seals.
28. Lever axial retaining bolt (16).
29. Casing.
30. Circlip.
31. Front grooved sleeve.
32. Clearance adjustment ring (L).
33. Circlip.
34. Slip gauges (quantity = 2).
L. Sleeve end float (31).
M. Clearance =0.0295 in. (0.75 mm). between parts (18) and (34).



4

DESCRIPTION AND OPERATION OF THE ELECTRO-HYDRAULICALLY ENGAGED DRIVE GEAR

The electro-hydraulically operated **4WD is engaged** by pressing the switch on the control panel.
By turning on the switch, the electrical impulse to the solenoid valve control relay is cut off. With the solenoid valve de-energised, the oil supply to the mobile coupling internal chamber is interrupted (19, fig. 3, causing the parts (8 and 19) to engage and the oil to drain from the control circuit (see fig. 4).

4WD **is disengaged** by turning off the switch on the control panel. This sends an impulse to the relay which, in turn, energises the control solenoid valve.
With the solenoid valve energised, oil is supplied to the mobile coupling internal chamber (19, fig. 3) and the 4WD disengages.
Lubrication is guaranteed by the oil in the rear transmission gearbox.

DESCRIPTION AND OPERATION

The drive gear housing is mounted below the rear transmission casing and is driven by the transmission shaft via gear unit (10, fig. 3).

Drive is then transmitted from the shaft (1) to the front axle by means of the propeller shaft that connects the two units.

Drive gear engagement and disengagement (see description on page 5) is made with the switch on the control panel. A light on the control panel illuminates when the drive gear is engaged.

ELECTROHYDRAULIC DRIVE GEAR TROUBLESHOOTING

Problems	Possible Causes	Solutions
4WD does not engage.	**1.** Drive gear engage/disengage switch faulty.	Replace switch.
	2. Solenoid valve control contactor faulty.	Check relay. Replace if necessary.
	3. Drive gear solenoid valve control jammed in delivery position.	Check solenoid valve. Replace if necessary.
	4. Spring (7, fig. 3) yielded.	Overhaul the unit.
4WD remains engaged.	**1.** Transmission oil level insufficient.	Top up oil level.
	2. Clogged oil filter.	Replace filter.
	3. Hydraulic pump faulty.	Overhaul or replace pump.
	4. Drive gear engage/disengage switch faulty.	Replace switch.
	5. No power at solenoid valve: connections loose or damaged, contactor defective.	Check electrical connections and replace defective parts.
	6. Drive gear solenoid valve control jammed in discharge position.	Overhaul or replace solenoid valve.
	7. Oil leakage through seals, leading to drop in pressure: hub, piston or delivery union seals, or drive gear shaft seal rings.	Replace all defective seals.
With electrohydraulic 4WD disengaged, drive cannot be engaged by operating the brake pedals.	**1.** Brake pump pressure switch faulty.	Replace the pressure switch.

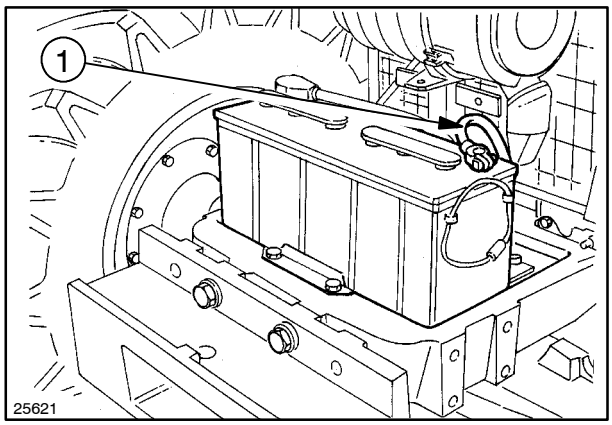
Op. 23 202 20
SERVICES CONTROL VALVE R.I.

DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

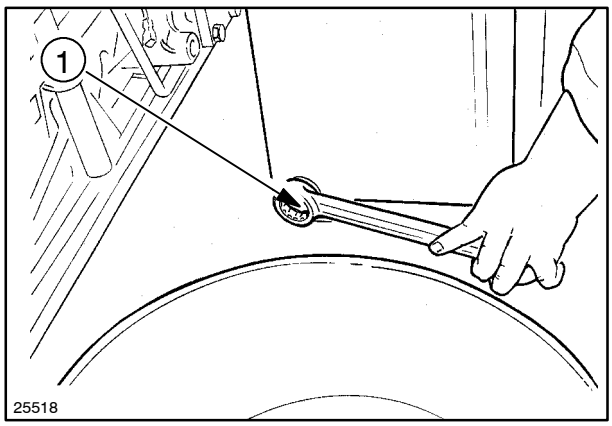
To remove the Services Control Valve, proceed as follows:

1. Disconnect the battery negative lead (1).



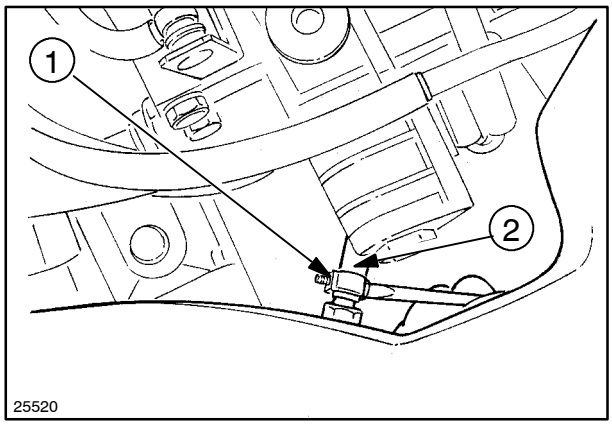
5

2. Remove the plug (1) and drain off the fuel tank into a suitable container (tank capacity is 110 litres).
3. Lock the front wheels using chocks.
4. Remove the rear left hand wheel.



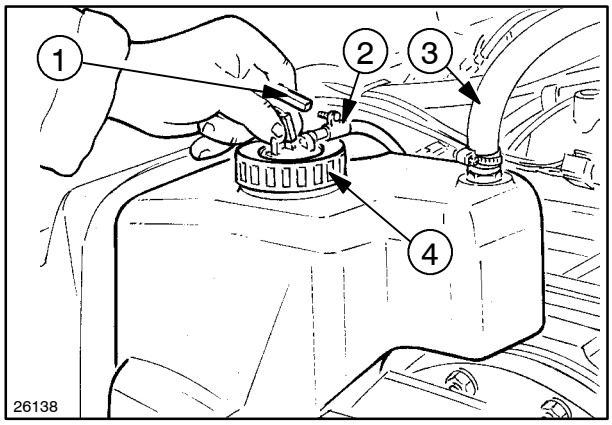
6

5. Take off the clamp (1) and remove the pipe (2) supplying the injection pump.



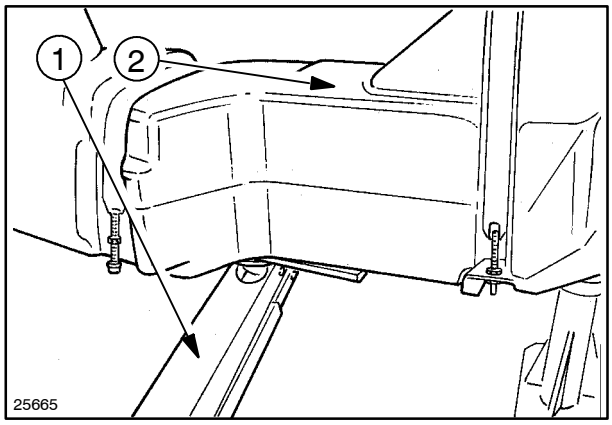
7

6. Disconnect the electrical connections (1) and the fuel return line (2) located on the fuel gauge unit (4) and detach the breather pipe (3).



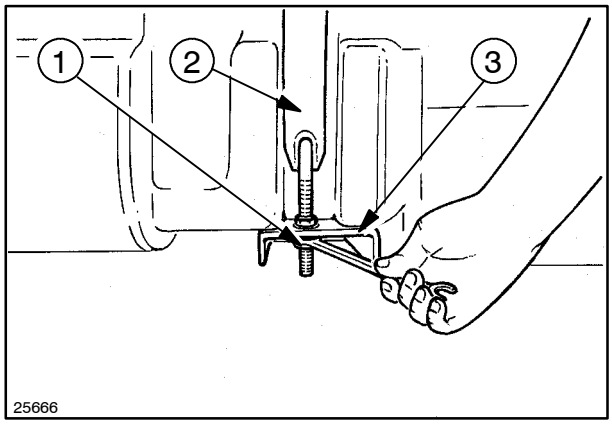
8

7. Position a hydraulic jack (1) under the central part of the tank (2) and slightly raise the tank.



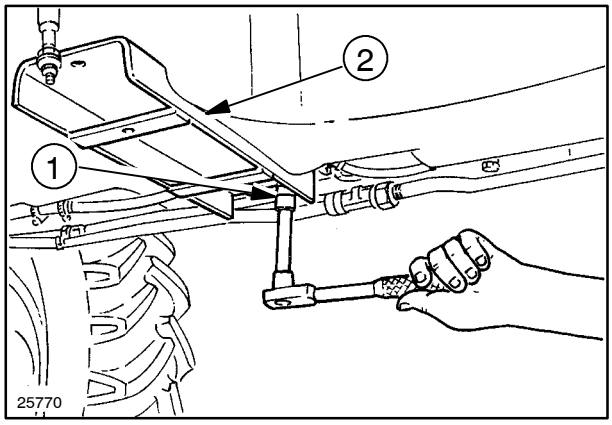
9

8. Remove the nut (1) securing the clamp (2) and detach the clamp from the support (3). Repeat the same operation on the front part.



10

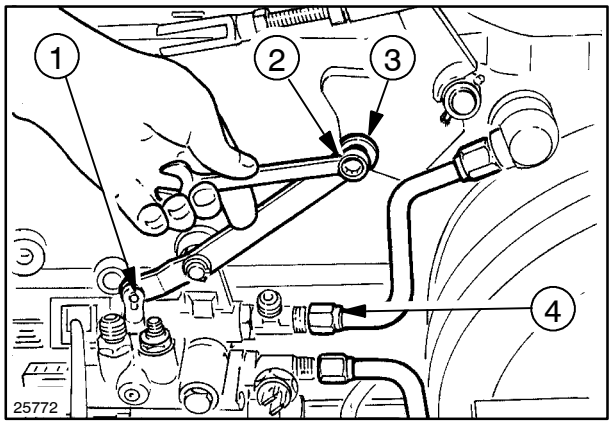
9. Take out the bolts (1) and remove the bracket (2) supporting the fuel tank. Repeat the same operation on the front bracket and remove the tank.



11

10. Disconnect the piping (4) on the solenoid valve support, unscrew the retaining bolt with the eccentric nut (2) to adjust the control valve rod stroke (1) and lever (3).

NOTE: *The control valve rod (1) hydraulically excludes PTO engagement governed by the flywheel when the PTO is synchronized with the gearbox.*



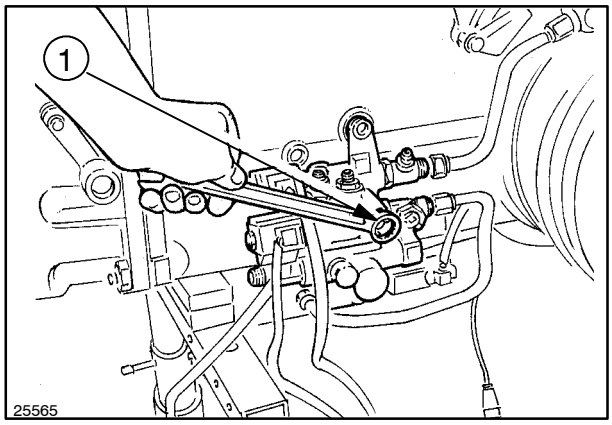
12

11. Take out the bolts (1) securing the services control valve to the gearbox and remove the control valve.

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts. Wear suitable safety clothing – safety goggles, gloves and shoes.



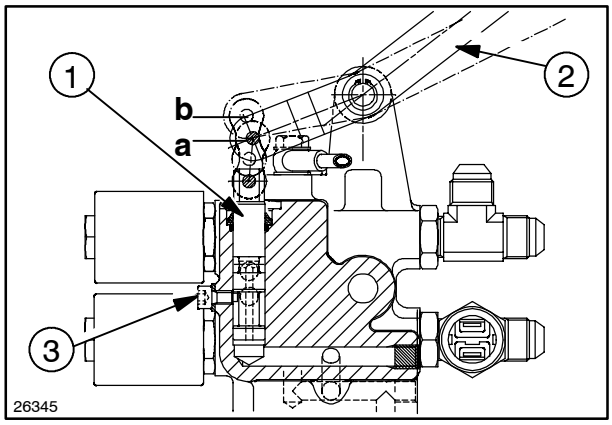
13

12. To refit the services control valve, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Attach the control valve to the gearbox casing with the bolts (1, fig. 13).
- Connect the lever (2, fig. 14) governing the control valve rod (1) and, using the eccentric nut (2, fig. 12), adjust the control valve rod (1, fig. 14) so as to leave a clearance between the valve (1) and the grub screw (3) at the limit stops:
- **a**) PTO synchronized with the gearbox.
- **b**) PTO electrohydraulically governed by the engaged flywheel.
- Reconnect the control valve delivery and return lines.
- Fit the tank with the clamps and support brackets, as shown in the figures (9, 10 and 11).
- Reconnect the electrical connections (1, fig. 8), the fuel return line (2) located on the fuel gauge unit (4) and refit the breather pipe (3).
- Refit the injection pump fuel line.
- Refit the left-hand rear wheel, fill up the fuel tank and reconnect the battery negative lead.



14

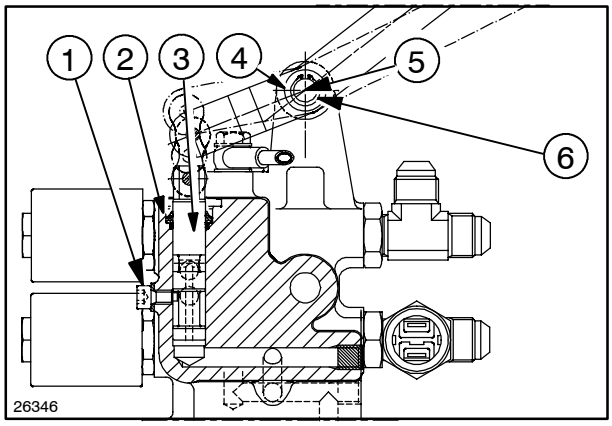
Op. 23 202 24
SERVICES CONTROL VALVE (FOR TRACTORS WITHOUT DUAL COMMAND [2 SPEED POWER SHIFT]) D.A.

Proceed as follows:

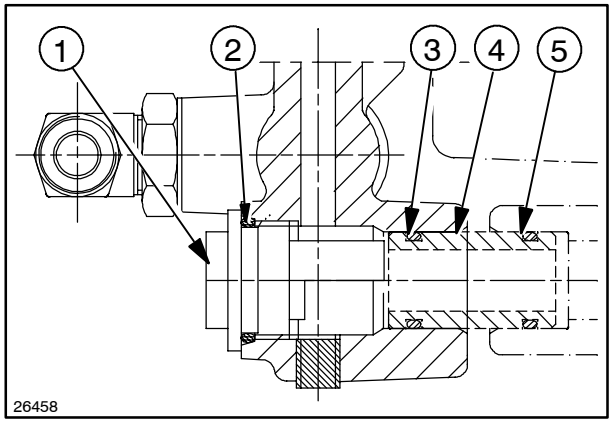
1. Remove the circlip (6), washer (4) and fulcrum pin (5).

2. Loosen the limit stop screw (1) and take out the valve (3). Remove the O-ring and the dust ring (2).
3. Remove the plug (1) located on the transmission drainage line and check the seal (2).

NOTE: *Also check seals (3 and 5) on the union (4) located on the transmission casing drainage line.*

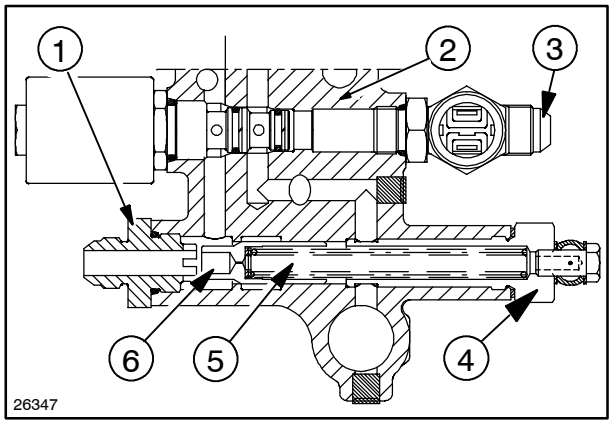


15



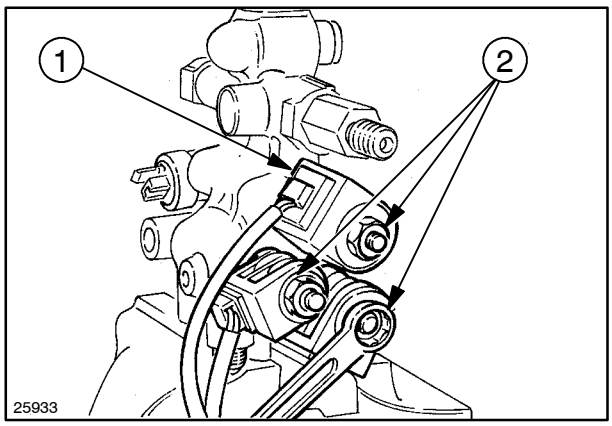
16

4. Remove the front and rear differential lock delivery union (3).
5. Remove the delivery union (1) on the solenoid valve support (2).
6. Remove the union connecting the pressure relief valve to the drainage line (4).
7. Remove the spring (5) and the pressure relief valve (6).



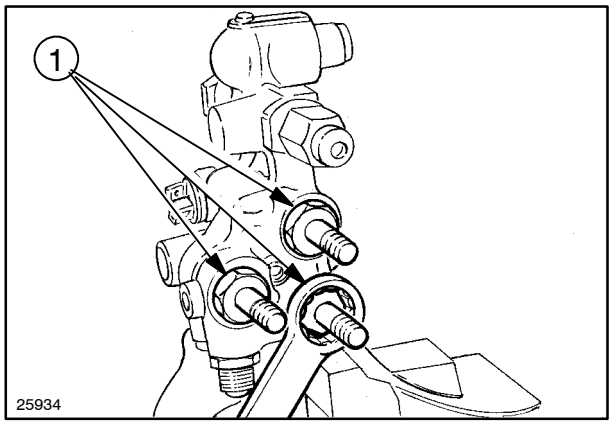
17

8. Position the Services control valve support in a vice, unscrew the nuts (2) and detach the solenoid valve coils (1). (Mark the detached coils.)



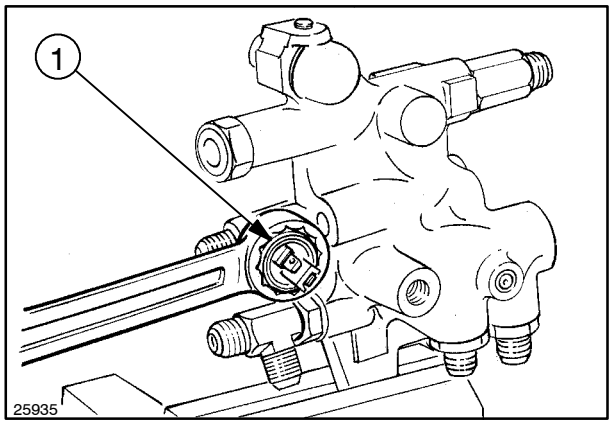
18

9. Remove the three pins (1) on the solenoid valves. Inspect the seals and replace if necessary.



19

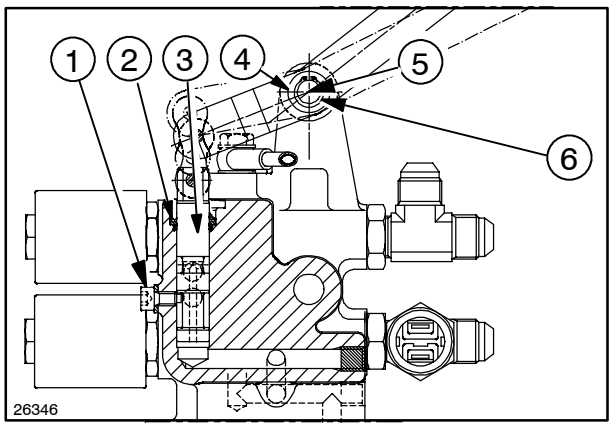
10. Remove the pressure gauge (1); and check its condition.



20

11. To reassemble the Services control valve, proceed as follows:

- Check all the seals and replace if necessary.
- Check and clean all mechanical parts.
- Refit the pressure gauge (1, fig. 20).
- Refit the three pins on the solenoid valves and tighten the nuts (1, fig. 19) to a torque value of (4.8 to 5.5 kgm).
- Refit the coils (1, fig. 18) on the solenoid valves, tighten the nuts (2) to a torque of (0.55 to 0.83 kgm).
- Refit the plug (1, fig. 16).
- Reassemble the pressure relief valve parts as shown in fig. 17.
- Refit the seal ring and dust ring (2, fig. 21).
- Reposition the valve (3) and bolt (1).
- Mount the control lever on the fulcrum pin (5), insert the washer (4) and the retaining circlip (6).
- Refit the front and rear differential lock delivery union (7).



21

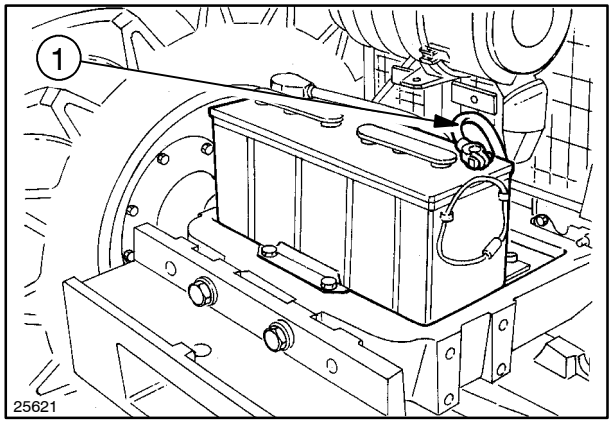
Op. 23 202 50
DRIVE GEAR ASSEMBLY R.I.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

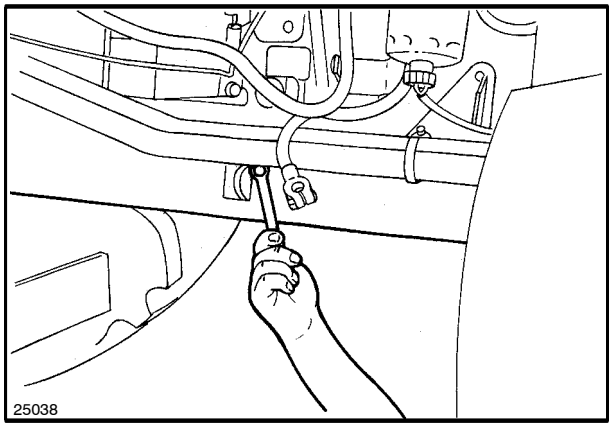
Proceed as follows:

1. Disconnect the battery negative cable (1).



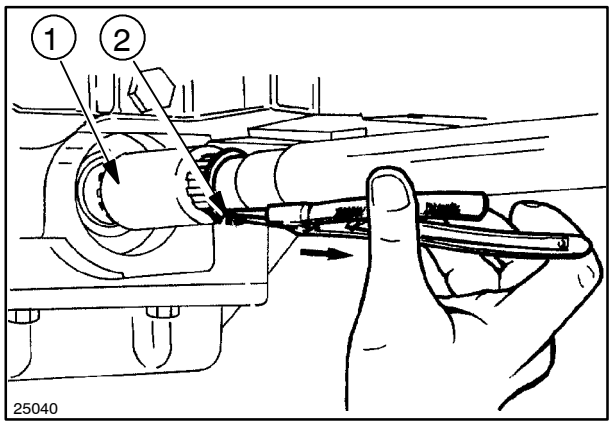
22

2. Unscrew the front, central and rear drive gear shaft guard retaining bolts.



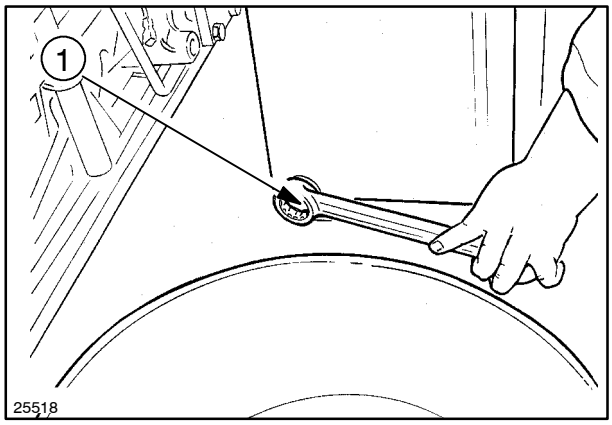
23

3. Remove the circlip (2) and move the sleeve (1) in the direction indicated by the arrow until it is released from the groove on the drive.



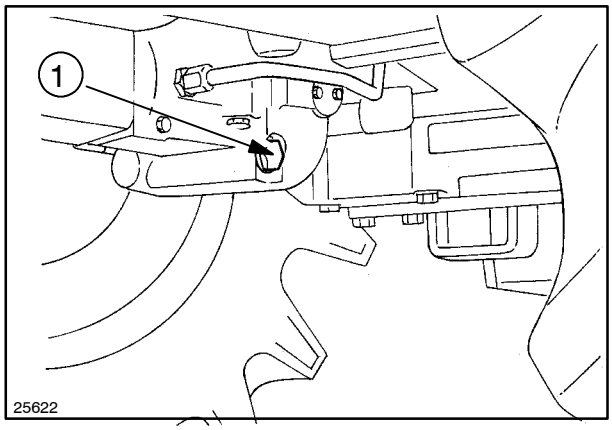
24

4. Take out the plug (1) and drain the tank; recover the fuel in a container positioned under the tank.



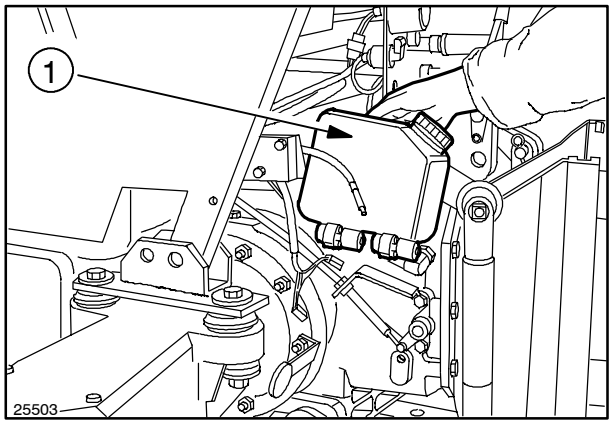
25

5. Take out the plug (1) and drain the oil from the gearbox/transmission casing.



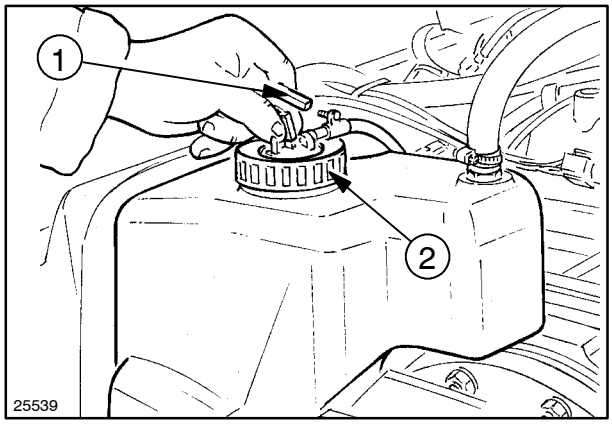
26

6. Detach the window washer tank (1) together with the relative electrical connections.



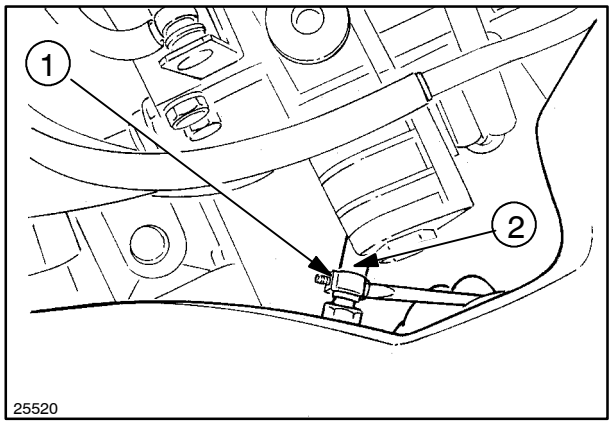
27

7. Disconnect the electrical connections (1) on the floating cap (2).



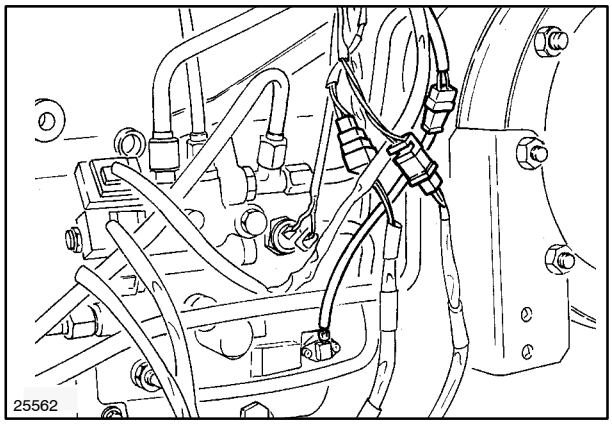
28

8. Remove the metal clamp (1) and detach the fuel return lines ((2) on the tank, also detach the fuel priming line.



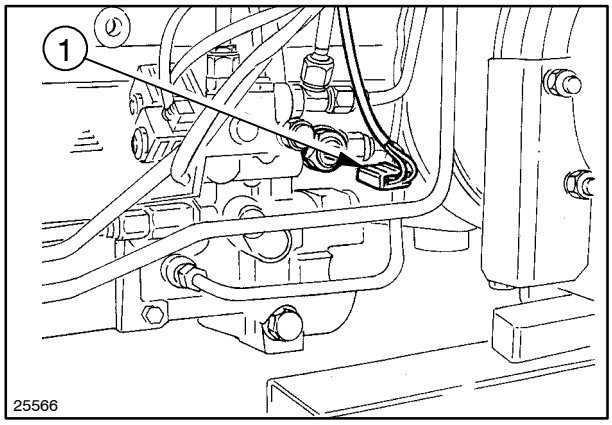
29

9. Mark and disconnect the 4WD, PTO engagement, differential lock, rev counter and pressure gauge control connections.



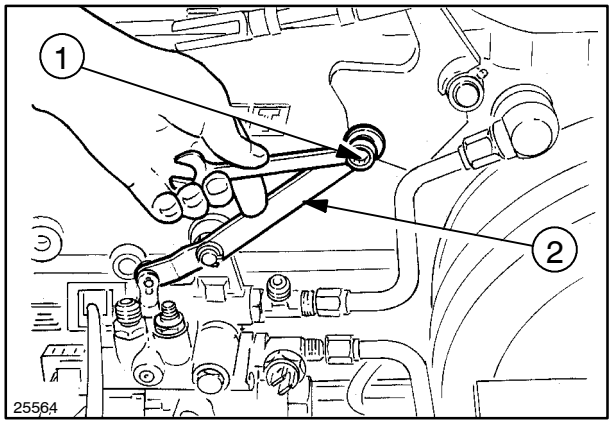
30

10. Disconnect the pressure gauge electrical connection (1).



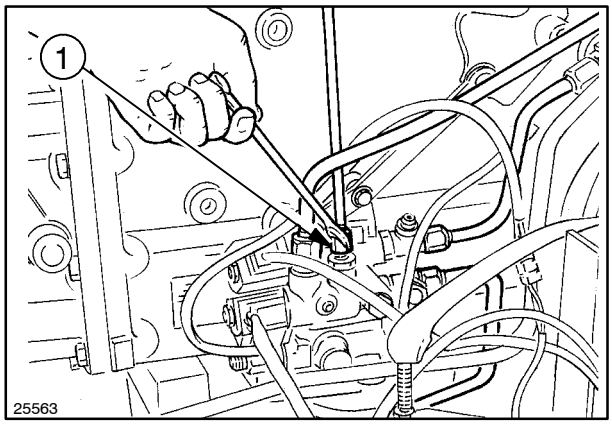
31

11. Take out the bolt (1) and remove the valve lever (2) on the p.t.o. control valve when this is synchronized with the transmission.



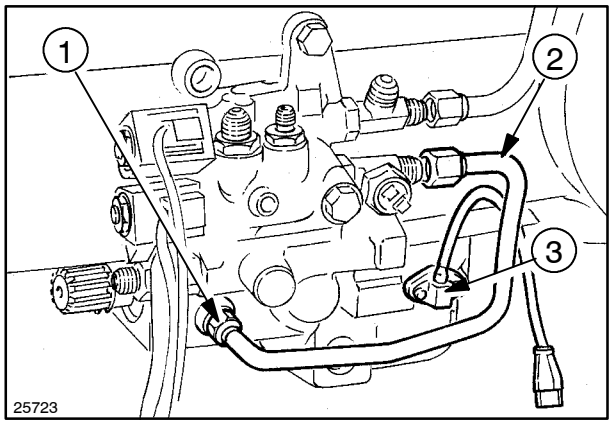
32

12. Remove the lines (1) on the services control valve.



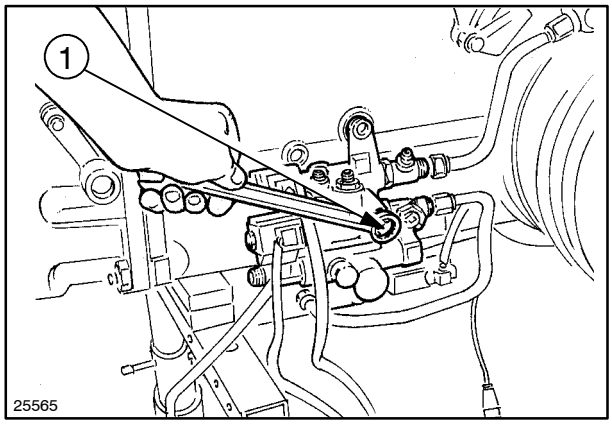
33

13. Remove the union (1) and detach the delivery line (2) for drive gear engagement. Detach the 4WD rev counter (3).



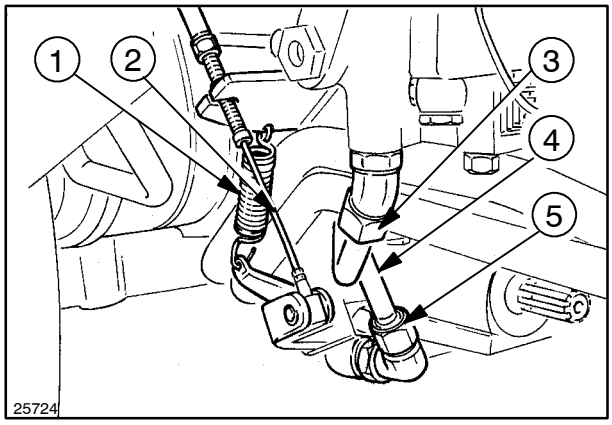
34

14. Take out the two bolts (1) securing the services control valve to the gearbox/transmission casing. Remove the control valve.



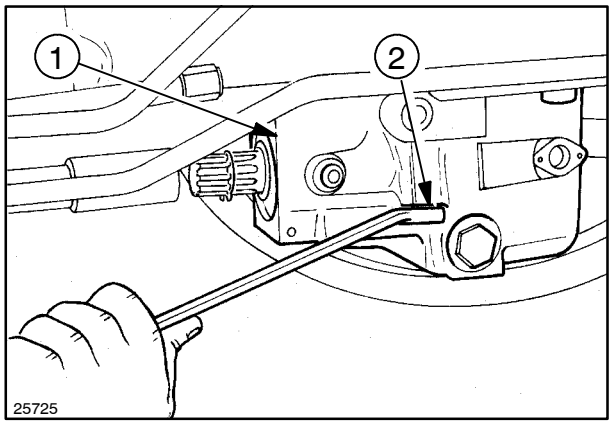
35

15. Detach the parking brake return spring (1). Remove the pin and detach the tie-rod (2). Remove the unions (3 and 5) and detach the lubrication line (4).



36

16. To facilitate disassembly of the drive gear casing, loosen the oil suction lines on the services pump, located under the casing.
17. Position a hydraulic jack under the drive casing (1). Take out the bolts (2) securing the drive casing to the gearbox/transmission casing. Remove the drive gear casing.



37

18. To refit the 4WD casing to the gearbox/transmission casing proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Carefully clean the contact surfaces.
- Apply a bead of approximately 0.0787 in. (2 mm) of sealing compound on the transmission casing mating surface and, with the aid of a hydraulic jack, fit the drive casing onto this, tightening the retaining bolts to the prescribed torque (see page 3).
- Reconnect the oil primer line, located under the transmission casing near the drive gear casing.
- Refit the 4WD sensor, securing in position with the two retaining bolts.
- Refit the drive gear casing/trailer brake control valve lubrication pipe.
- Remount the handbrake tie-rod on the locking rod.
- Fit the helical spring on the lever.
- Refit the services control valve.
- Tighten the piping and reconnect the three electrical connections on the solenoid valves.
- Refit the 4WD drive gear piping to the drive gear casing control valve.
- Reassemble the fuel tank, connect all hoses and the float electrical connection.
- Refit the window washer tank and the electric motor connections.
- Refit the drive gear shaft sleeve on the drive gear casing grooved shaft, securing in position with a snap ring.
- Refit the guard.
- Fill up the fuel tank using the pump.
- Fill the transmission/gearbox casing with oil.
- Bleed any air from the fuel circuit.
- Connect the battery negative cable.

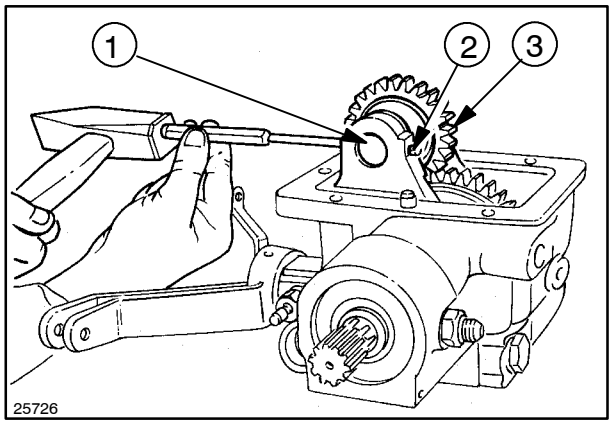
Op. 23 202 52
DRIVE GEAR HOUSING REMOVED R.I.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

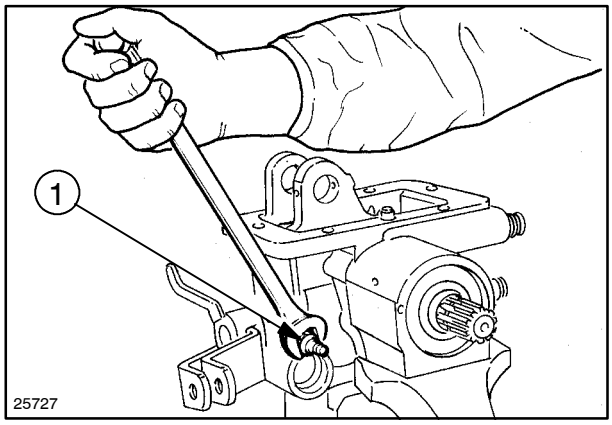
With the drive gear casing on a workbench, proceed as follows:

1. Using a punch, extract the circlip (2), pin (1) and remove the roller bearing, spacer, thrust washers and intermediate gear (3).



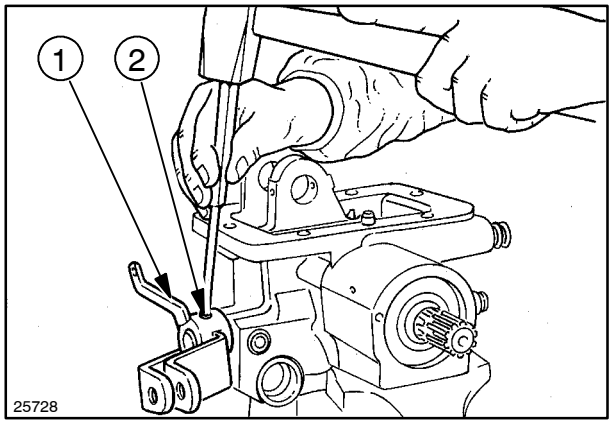
38

2. Unscrew the axial retaining screw (1) on the parking brake lever.



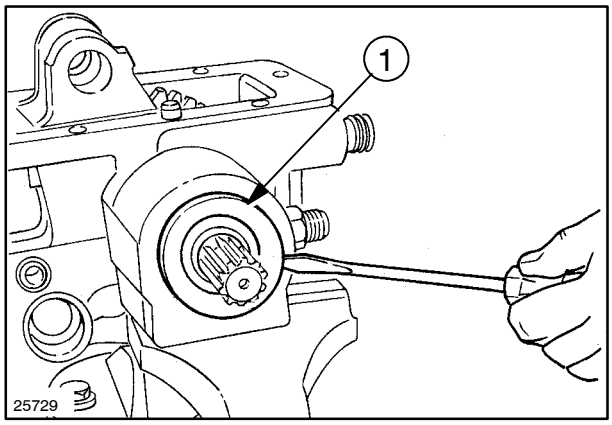
39

3. Using a punch, extract the circlip (2) and detach the parking brake lever (1).



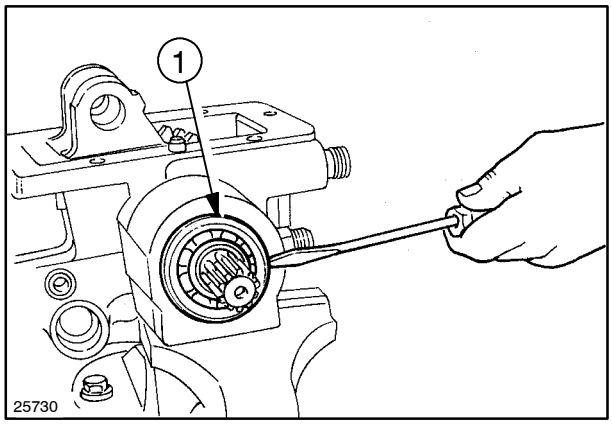
40

4. Using a screwdriver, remove the dust ring (1).



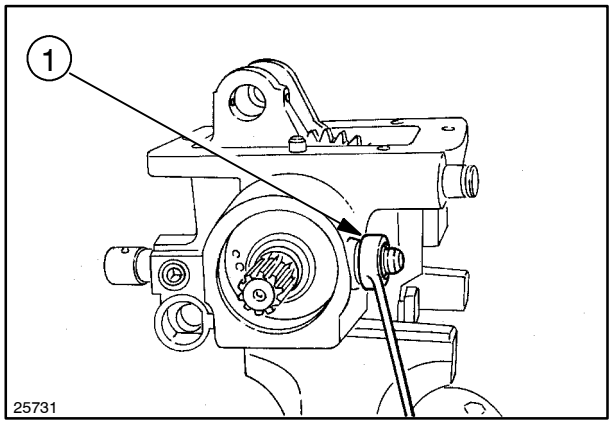
41

5. Remove the oil seal (1).



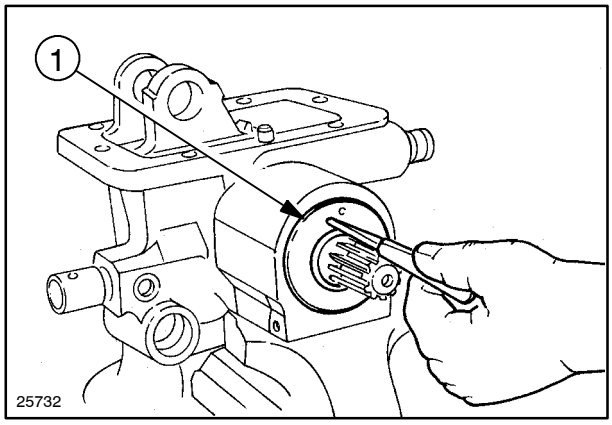
42

6. Remove the 4WD drive gear disengagement oil delivery union (1).



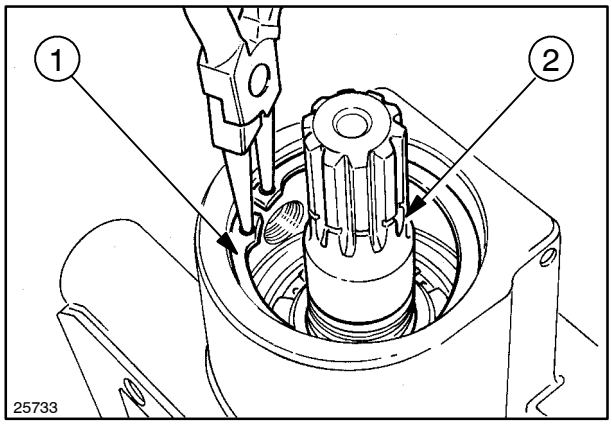
43

7. Remove the oil delivery manifold ring (1) with a suitable punch.



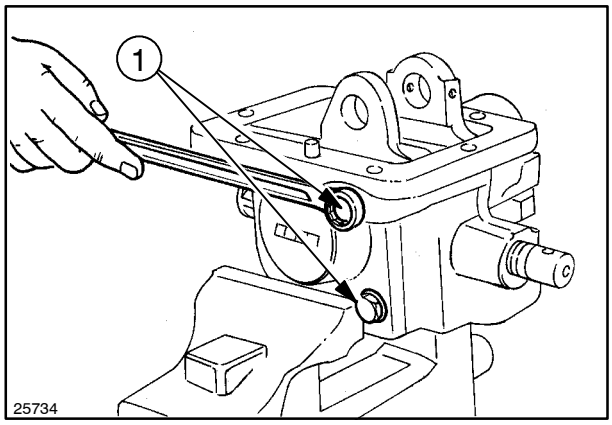
44

8. Remove the circlip (1). Extract the shaft (2), complete with parts (6, 7, 19, 20 and 21, page 4); remove the parking brake disks (12 and 14), the driven gear (18), fixed coupling (8) and thrust washer (17).



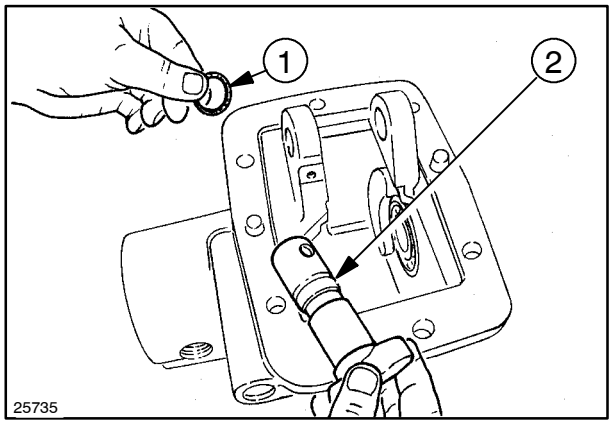
45

9. Unscrew the two bolts (1) with relative brake sector guide pins and remove the brake sector and rear bearing.



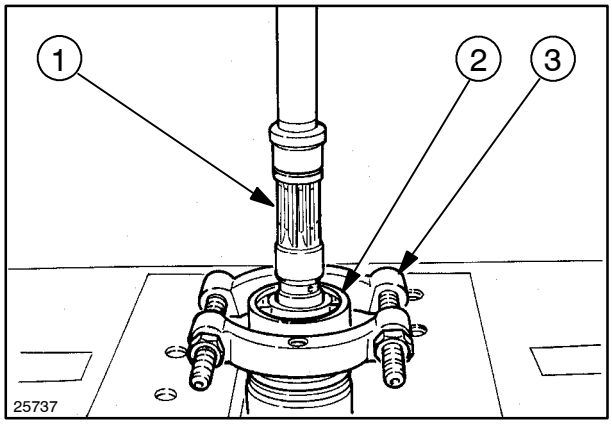
46

10. Extract the parking brake lever (2) and remove the O-ring (1) from the part (2).



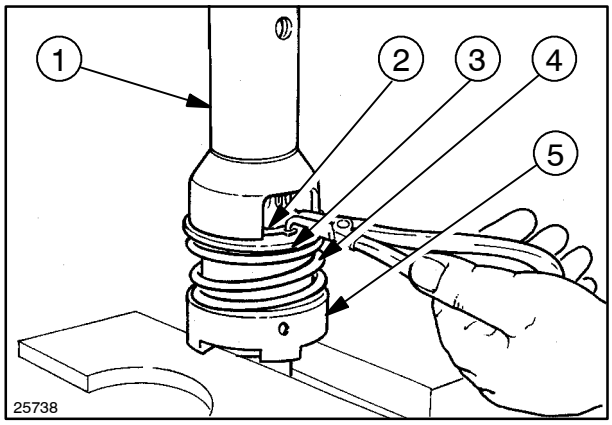
47

11. Position the driven shaft (1), previously removed in operation (8), in a hydraulic press, securing the bearing (2) in the clamps (3) as indicated in the drawing. Operate the press and extract the bearing (2).



48

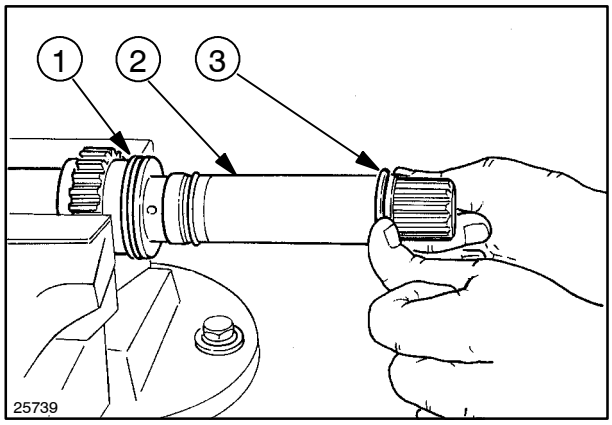
12. Rotate the driven shaft through 180°, position on the press as indicated in the drawing and, after having fitted an adapter (1) on the shaft, operate the press to compress the spring (4).
Remove the snap ring (2), plate (3), spring (4) and mobile toothed coupling (5).



49

13. **Assembly.**

To reassemble the drive gear components, follow the disassembly operations described in reverse order.



50

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Check all parts and replace if worn.
- Check the seals and replace, if necessary.
- To position the O-rings (26 and 27, fig. 3) on the driven shaft, use the special tools: **380000280** (2) for seal (3) and tool **380000279** for seal (1).
- Lubricate all parts.
- Tighten the retaining bolts to the torque value indicated on page 3.

SECTION 25 - FRONT AXLE MECHANICAL TRANSMISSION

Chapter 1 - Front axle mechanical transmission

CONTENTS

Operation	Description	Page
	Data	2
	Tightening Torques	4
	Tools	6
	Cross-sectional views	9
	Description of LIM-SLIP self-locking differential operation	14
	Description of front differential lock operation	15
	Fault diagnosis	16
25 100 30	Front axle R.I.	17
25 100 38	Front axle D.A. - Overhaul	21
25 102 24	Front axle differential - Overhaul	30
25 102 27	Front axle differential with LIM-SLIP unit - Overhaul	31
25 104 34	Differential lock clutch assembly - Overhaul	33
25 108 30	Front epicyclic final drive without brake D.A.	35
25 108 30	Front epicyclic final drive with brake D.A.	39
25 108 46	Steering knuckle pins and bearings	42
	Adjustments	43
	Leading wheels. Toe-in check	(See operation **44 511 80**)

DATA

Type		steering, load bearing structure, pivoting at centre
Bevel drive - differential		
Pinion-crown gear ratio:		
- model TL70		9/29 = 1:32.2
- model TL80		10/35 = 1:3.5
- Models TL90 and TL100		9/39 = 1:4.33
Pinion-crown gear ratio 24.85 mph (40 km/h):		
- Models TL70		11/29 = 1:2.64
- model TL80		11/31 = 1:2.82
- Models TL90 and TL100		11/39 = 1:3.54
Backlash between bevel drive teeth:		
- Models TL70 and TL80	in. (mm)	0.0070 to 0.0090 (0.18 to 0.23)
- Models TL90 and TL100	in. (mm)	0.0059 to 0.0078 (0.15 to 0.20)
Thickness of bevel pinion position adjustment spacer rings (11, fig. 6 and 7)	in. (mm)	0.0984 - 0.1023 - 0.1062 - 0.1102 - 0.1141 - 0.1181 - 0.1220 - 0.1259 - 0.1299 - 0.1338 - 0.1377 - 0.4117 - 0.1456 (2.5 - 2.6 - 2.7 - 2.8 - 2.9 - 3.0 - 3.1 - 3.2 - 3.3 - 3.4 - 3.5 - 3.6 - 3.7)
Thickness of bevel pinion bearing adjustment spacer rings (12)	in. (mm)	0.0984 - 0.1003 - 0.1023 - 0.1043 - 0.1062 - 0.1082 - 0.1102 - 0.1122 - 0.1141 - 0.1161 - 0.1181 - 0.1200 - 0.1220 - 0.1240 - 0.1259 - 0.1279 - 0.1299 - 0.1318 - 0.1338 - 0.1377 - 0.1358 - 0.1397 - 0.1417 - 0.1437 - 0.1456 - 0.1476 - 0.1496 - 0.1515 - 0.1534 - 0.1555 - 0.1574 - 0.1594 - 0.1614 - 0.1633 - 0.1653 - 0.1673 - 0.1692 - 0.1712 - 0.1732 - 0.1751 - 0.1771 - 0.1791 - 0.1811 - (2.5 - 2.55 - 2.6 - 2.65 - 2.7 - 2.75 - 2.8 - 2.85 - 2.9 - 2.95 - 3.00 - 3.05 - 3.1 - 3.15 - 3.2 - 3.25 - 3.3 - 3.35 - 3.4 - 3.45 - 3.5 - 3.55 - 3.6 - 3.65 - 3.7 - 3.75 - 3.8 - 3.85 - 3.9 - 3.95 - 4.00 - 4.05 - 4.1 - 4.15 - 4.2 - 4.25 - 4.3 - 4.35 - 4.4 - 4.45 - 4.5 - 4.55 - 4.6 - 4.65 - 4.7 - 4.75 - 4.8)
Thickness of bevel crown wheel position adjustment spacer rings (4)	in. (mm)	0.0354 - 0.0393 - 0.0433 - 0.0472 - 0.0511 - 0.0551 - 0.0590 - 0.0629 - 0.0669 - 0.0708 - 0.0748 - 0.0787 (0.9 - 1 - 1.1 - 1.2 - 1.3 - 1.4 - 1.5 - 1.6 - 1.7 - 1.8 - 1.9 - 2)
Clearance between sun and planet pinion tooth flanks	in. (mm)	0.0059 (0.15)
Thickness of planet pinion thrust washers (1)	in. (mm)	0.0578 to 0.0602 (1.470 to 1.530)
Thickness of sun pinion thrust washers	in. (mm)	0.0551 - 0.0590 - 0.0629 - 0.0669 - 0.0708 (1.4 - 1.5 - 1.6 - 1.7 - 1.8)
Diameter of cross pin (14) for planet pinions:		
- Models TL70 and TL80	in. (mm)	0.8637 to 0.8645 (21.939 to 21.960)
- Models TL90 and TL100	in. (mm)	0.9424 to 0.9433 (23.939 to 23.960)
Planet pinion cross pin bore diameter (3):		
- Models TL70 and TL80	in. (mm)	0.8677 to 0.8685 (22.040 to 22.061)
- Models TL90 and TL100	in. (mm)	0.9464 to 0.9472 (24.040 to 24.061)
Assembly clearance between cross pin and bores	in. (mm)	0.0031 to 0.0048 (0.080 to 0.122)

(continued)

DATA

(cont)

Planet pinion hub diameter (2, fig. 6 and 7) (models TL90 and TL100)	in. (mm)	1.7307 to 1.7322 (43.961 to 44.000)
Sun gear hub seat diameter on differential casing (models TL90 and TL100)	in. (mm)	1.7354 to 1.7369 (44.080 to 44.119)
Assembly clearance between sun pinions and seats (models TL90 and TL100)	in. (mm)	0.0031 to 0.0062 (0.080 to 0.158)
Differential lock		
Spring free length (5, fig. 6 and 7):		
- Models TL70 and TL80	in. (mm)	~ 2.9527 (~ 75)
- Models TL90 and TL100	in. (mm)	~ 3.4251 (~ 87)
Spring length under load of:		
- 1370 to 1566N (139.7 to 159.7 kg) for models TL70 and TL80	in. (mm)	~ 1.6141 (~ 41)
- 1888 to 2035N (192.5 to 207.5 kg) for models TL90 and TL100	in. (mm)	~ 1.8897 (~ 48)
Axle shafts and steering knuckles		
Diameter of outer axle shafts (7, fig. 6 and 7) in correspondence with bushes (8):		
- Models TL70 and TL80	in. (mm)	1.7706 to 1.7716 (44.975 to 45.000)
- Models TL90 and TL100	in. (mm)	1.6525 to 1.6535 (41.975 to 42.000)
Inside diameter of installed bushes (8):		
- Models TL70 and TL80	in. (mm)	1.7755 to 1.7785 (45.100 to 45.175) (1)
- Models TL90 and TL100	in. (mm)	1.6574 to 1.6604 (42.100 to 42.175) (1)
Clearance between axle shafts and bushes		0.100 to 0.200
Interference fit between bushes and respective bores		0.064 to 0.129
Thickness of steering knuckle bearing adjuster plates (10)		0.10 - 0.15 - 0.20 - 0.25 - 0.30
Epicyclic final drives		
Gear ratio:		
- Models TL70 and TL80		12 : (12 + 60) = 1 : 6
- Models TL90 and TL100		16 : (16 + 62) = 1 : 4.875
Thickness of driven gear shims (9, fig. 6 and 7)	in. (mm)	0.0303 to 0.0326 (0.77 to 0.83)
Front axle brake disk thickness (4, fig. 5):		
- models TL70 and TL80	in. (mm)	0.1358 to 0.1397 (3.45 to 3.55)
- Models TL90 and TL100	in. (mm)	0.1751 to 0.1791 (4.45 to 4.55)
Axle pivot		
End float on pivot between axle body and relative supports (See fig. 8)	in. (mm)	0.0118 to 0.0433 (0.3 to 1.1)
Maximum permitted wear clearance	in. (mm)	0.0787 (2)

(1) Value to be obtained without refacing

(continued)

DATA

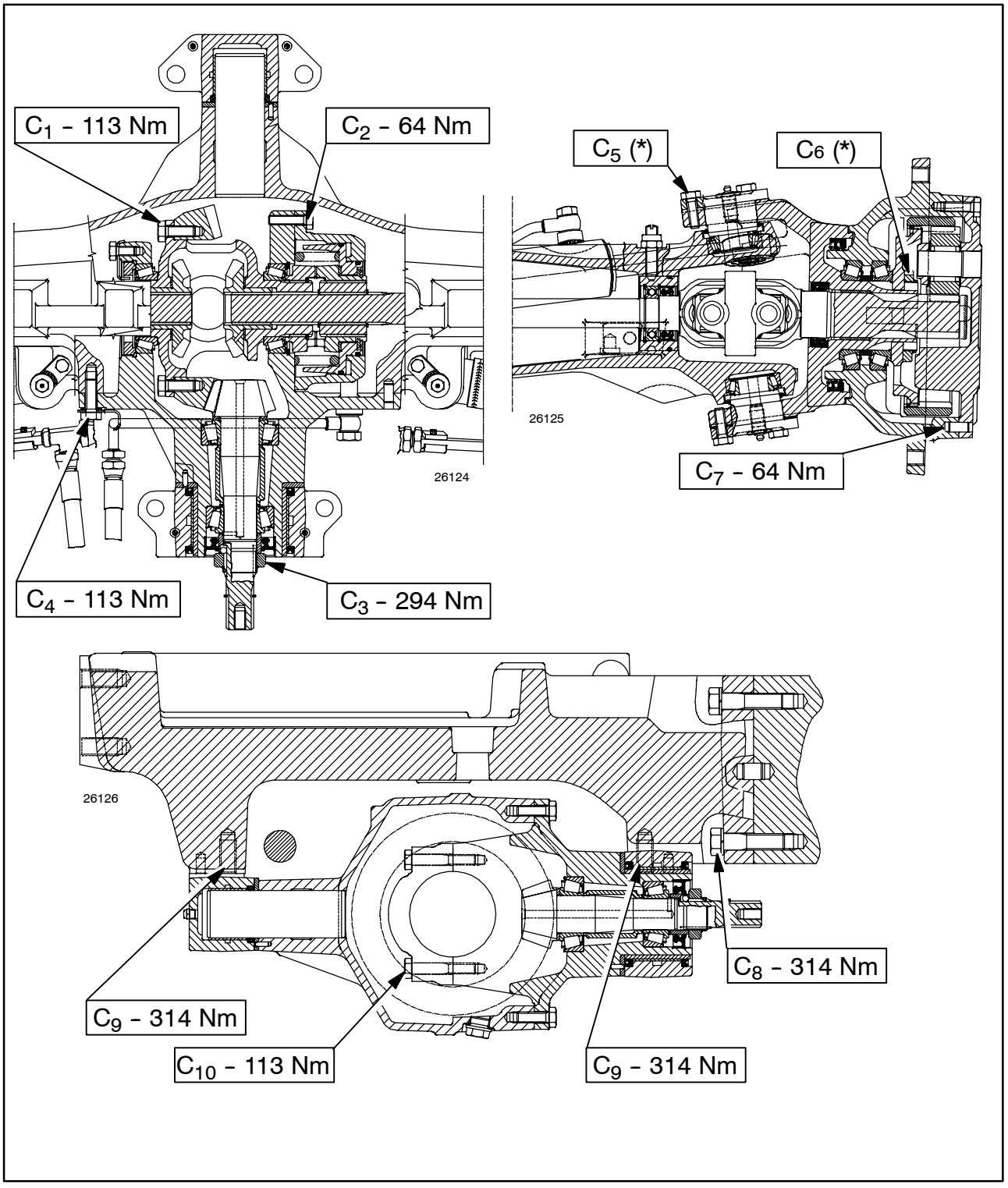
(cont)

Diameter of axle pivot front pin (3, fig. 8)	in. (mm)	2.0729 to 2.0736 (52.652 to 52.671)
Installed front bush internal diameter (1)	in. (mm)	2.0755 to 2.0783 (52.720 to 52.790) ([1])
Assembly clearance between pin (3) and bushing (1)	in. (mm)	0.0019 to 0.0054 (0.049 to 0.138)
Outside diameter of rear bushing (6) installed in the bevel pinion support	in. (mm)	3.8984 to 3.8996 (99.020 to 99.050)
Inside diameter of rear bush (5) installed in the axle pivot support	in. (mm)	3.9033 to 3.9063 (99.146 to 99.221) ([1])
Assembly clearance between the two bushes	in. (mm)	0.0037 to 0.0079 (0.096 to 0.201)
Thickness of the front (2) and rear (4) front axle thrust washers	in. (mm)	0.1929 to 0.1968 (4.90 to 5.00)

([1]) Measurement to be obtained without reaming

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Front axle			
Bevel crown wheel to differential casing retaining bolt (C_1, fig. 1)	M 12 x 1.25	113	11.5
Differential lock device retaining bolt (C_2)	M 10 x 1.25	64	6.5
Bevel pinion shaft locknut (C_3)	M 35 x 1.5	294	30
Differential bevel gear support to axle casing retaining bolt (C_4)	M 12 x 1.25	113	11.5
Steering knuckle pin retaining bolt (C_5):			
- Models TL70 and TL80	M 10 x 1.25	64	6.5
- Models TL90 and TL100	M 12 x 1.25	113	115
Wheel hub bearing locknut (C_6):			
- Models TL70 and TL80	M 70 x 2	392	40
- Models TL90 and TL100	M 75 x 2	392	40
Epicyclic final drive housing retaining bolt (C_7)	M 10 x 1.25	64	6.5
Front axle support to engine retaining bolt (C_8)	M 18 x 1.5	314	32
Front axle pivot front and rear support retaining bolt (C_9)	M 18 x 1.5	314	32
Differential housing support cap retaining bolt (C_{10})	M 12 x 1.25	113	11.5
Rim/disk retaining bolt nut	M 16 x 1.5	245	25
Brake piston retaining bolts (6, fig. 5):			
- models TL70 and TL80	M 10 x 1.25	75 to 82	7.6 to 8.4
- Models TL90 and TL100	M 18 x 1.5	209 to 232	21.3 to 23.7


C1 - 113 Nm
C2 - 64 Nm
C4 - 113 Nm
C3 - 294 Nm
26124
C5 (*)
C6 (*)
26125
C7 - 64 Nm
26126
C8 - 314 Nm
C9 - 314 Nm
C10 - 113 Nm
C9 - 314 Nm

1

(*) See page 4.

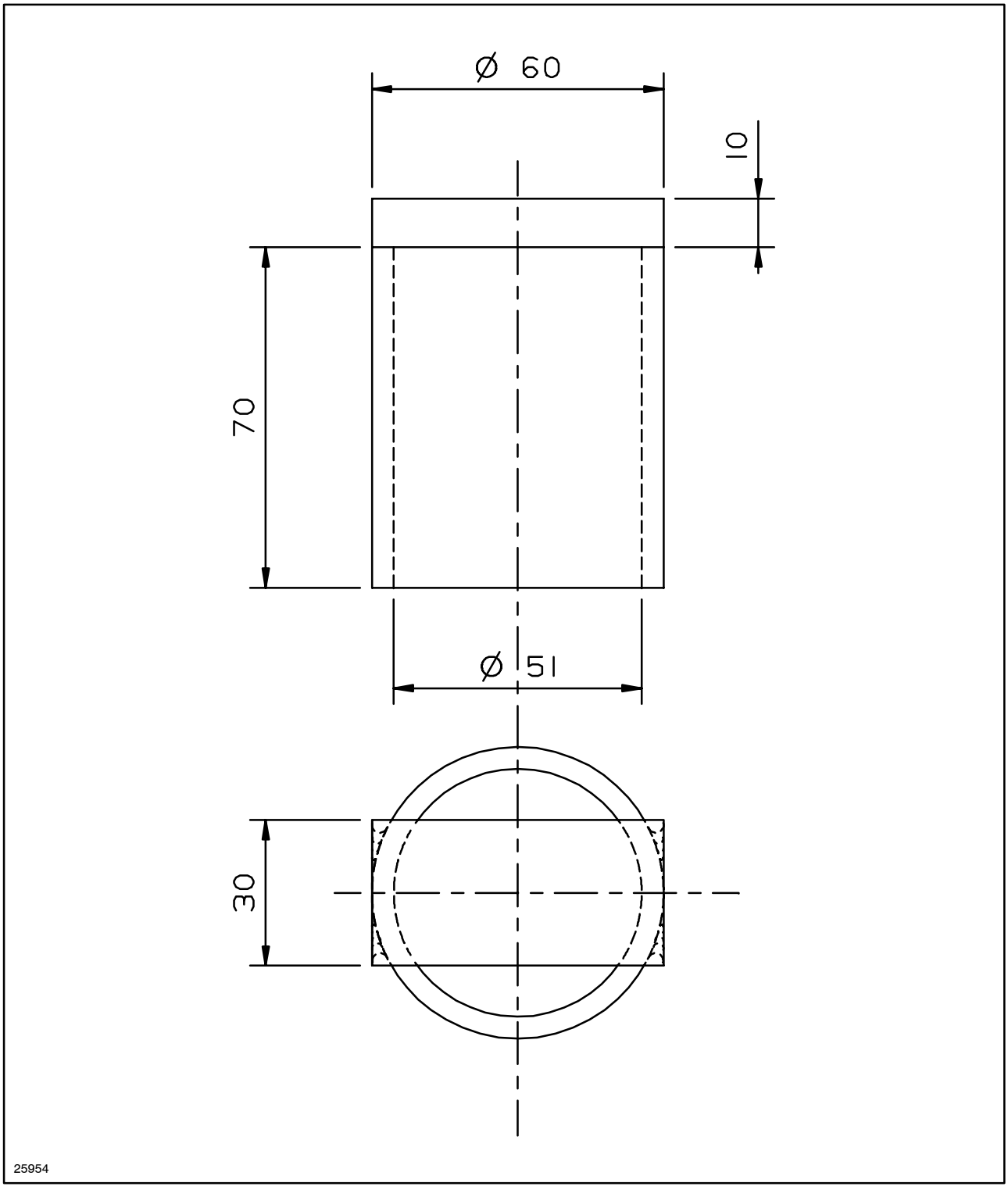
TOOLS

WARNING

The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

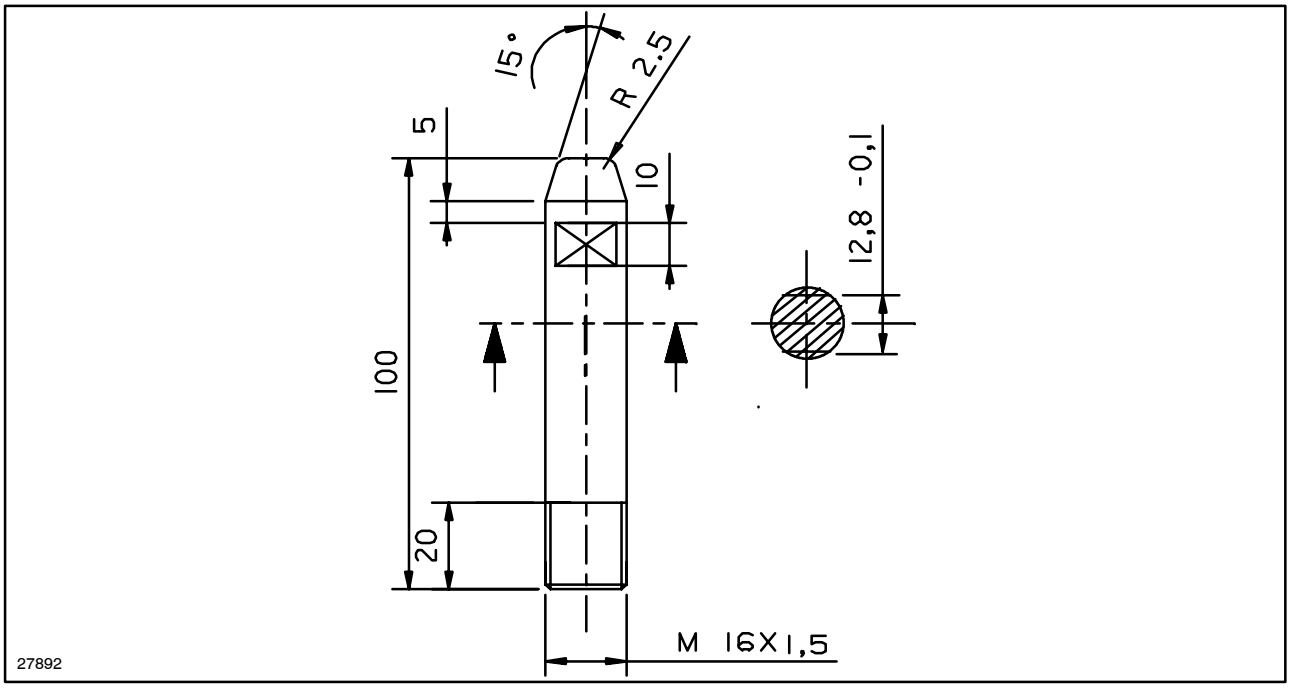
	380000251	Front axle overhaul stand.
	380000227	Front differential unit removal-installation hook.
	380000255	Front axle differential casing overhaul support.
X	**380000268**	Wrench for front bevel drive pinion ring nut.
X	**380000248**	Bevel pinion bearing adjustment tool.
X	**380000257**	Front bevel drive pinion retaining wrench.
	380000249	Universal gauge for positioning of front bevel drive pinion.
X	**380000252**	Wrench for front differential case bearing adjustment ring nut (models TL70 and TL80).
X	**380000253**	Wrench for front differential case bearing adjustment ring nut (models TL90 and TL100).
X	**380000295**	Wrench for front axle wheel hub bearing retaining ring nut (models TL70 and TL80).
X	**380000269**	Wrench for front axle wheel hub bearing retaining ring nut (models TL90 and TL100).
X	**380000270**	Pair of grips for front axle hub bearing extraction.
X	**380000265**	Front axle pivot pin removal tool.
X	**380000234**	Front axle pivot bearing outer ring removal tool.
X	**380000235**	Tool for measurement of rolling drag torque of front axle bearings.
	380000240	Universal kit for testing oil pressure for front axle differential lock engagement.
X	**380000287**	Wheel hub seal key (models TL70 and TL80).
X	**380000284**	Wheel hub sunken seal key (models TL90 and TL100).
X	**380000286**	Wheel hub seal key with brake (models TL70 and TL80).
X	**380000288**	Wheel hub seal key with brake (models TL90 and TL100).



2

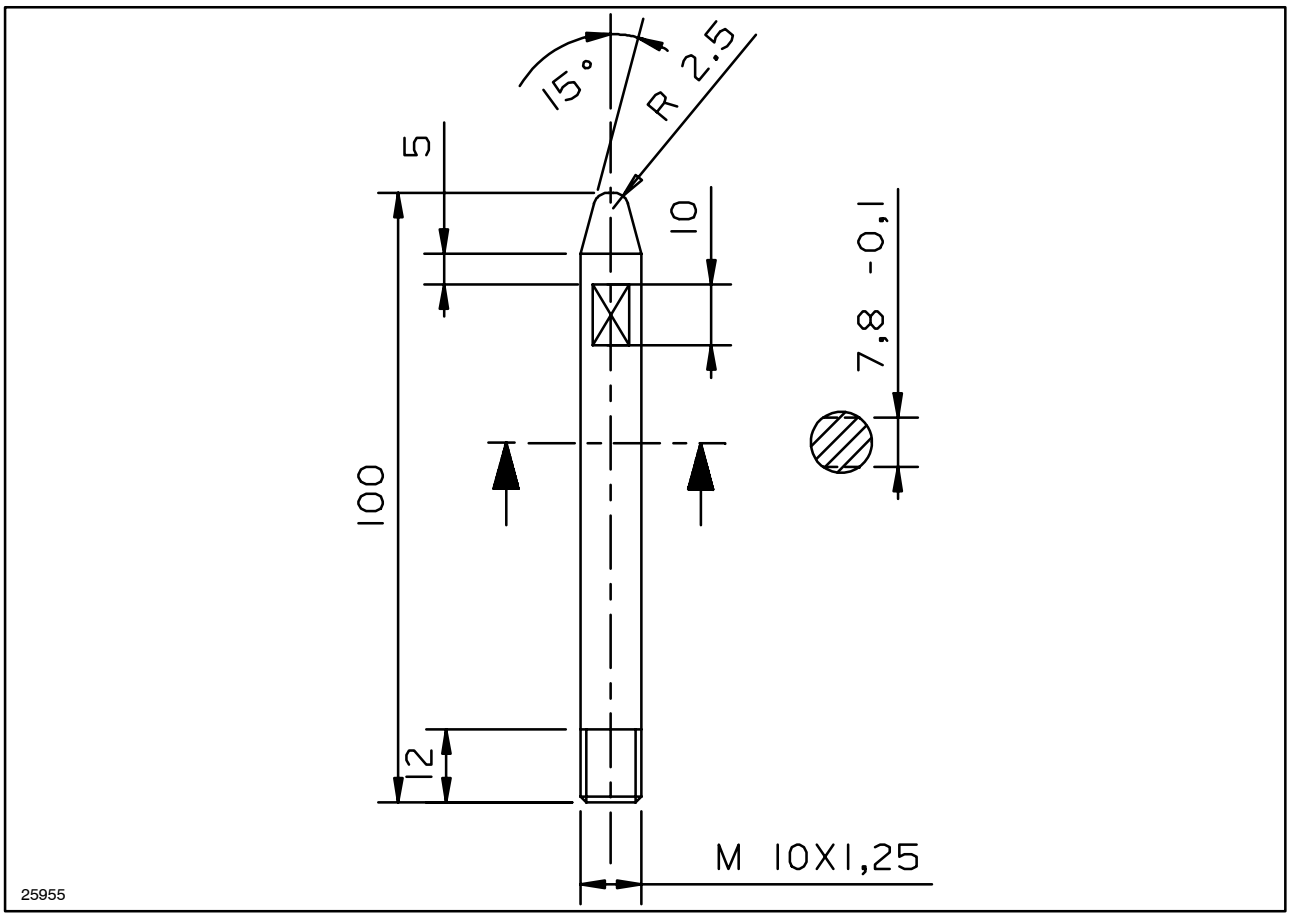
Tool to be made for hub bearing extraction - use with tool 380000270 (models TL90 and TL100) (mark tool with no. 50049 - Measurements in mm).

Make in UNI C40 material.



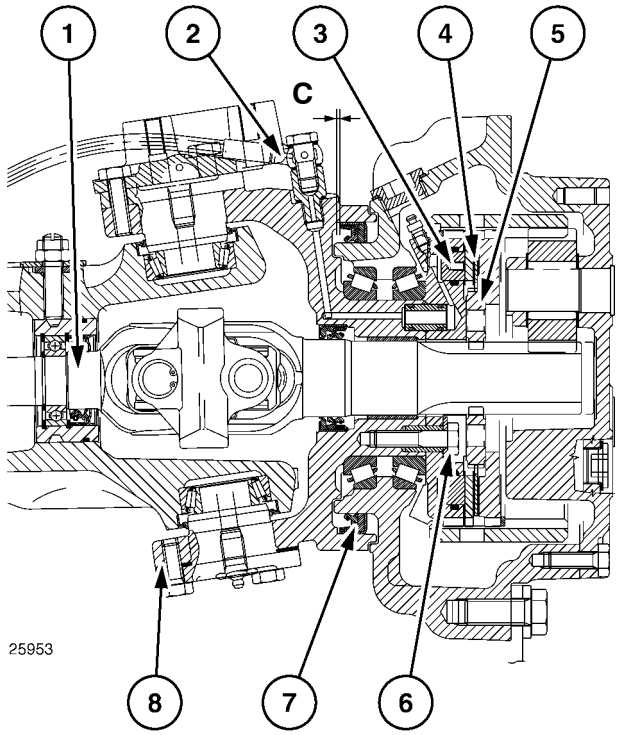
3

Tool to make for front axle wheel disassembly-assembly
(mark tool with no. 50165 - Measurements in mm)
Make in UNI C40 material.

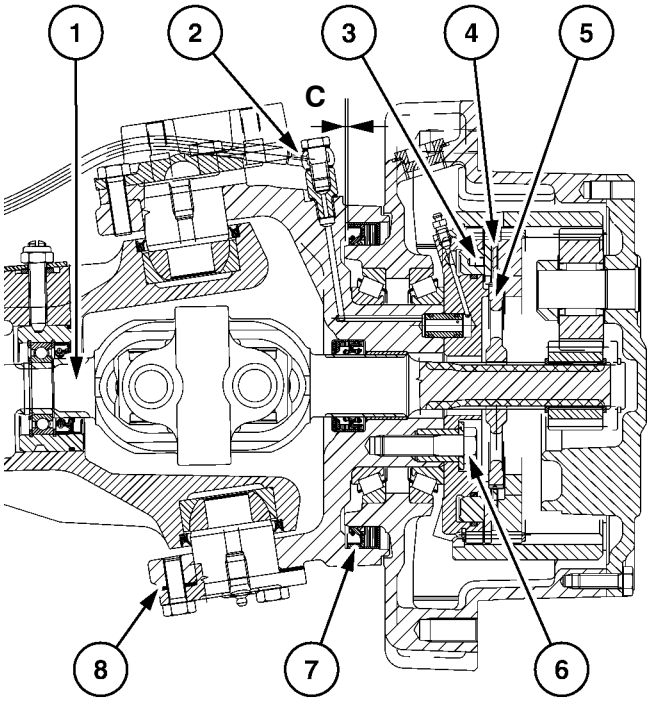


4

Tool to make for removal-installation of the final drive cover
(mark tool with no. 50164 - Measurements in mm)
Make in UNI C40 material.



A

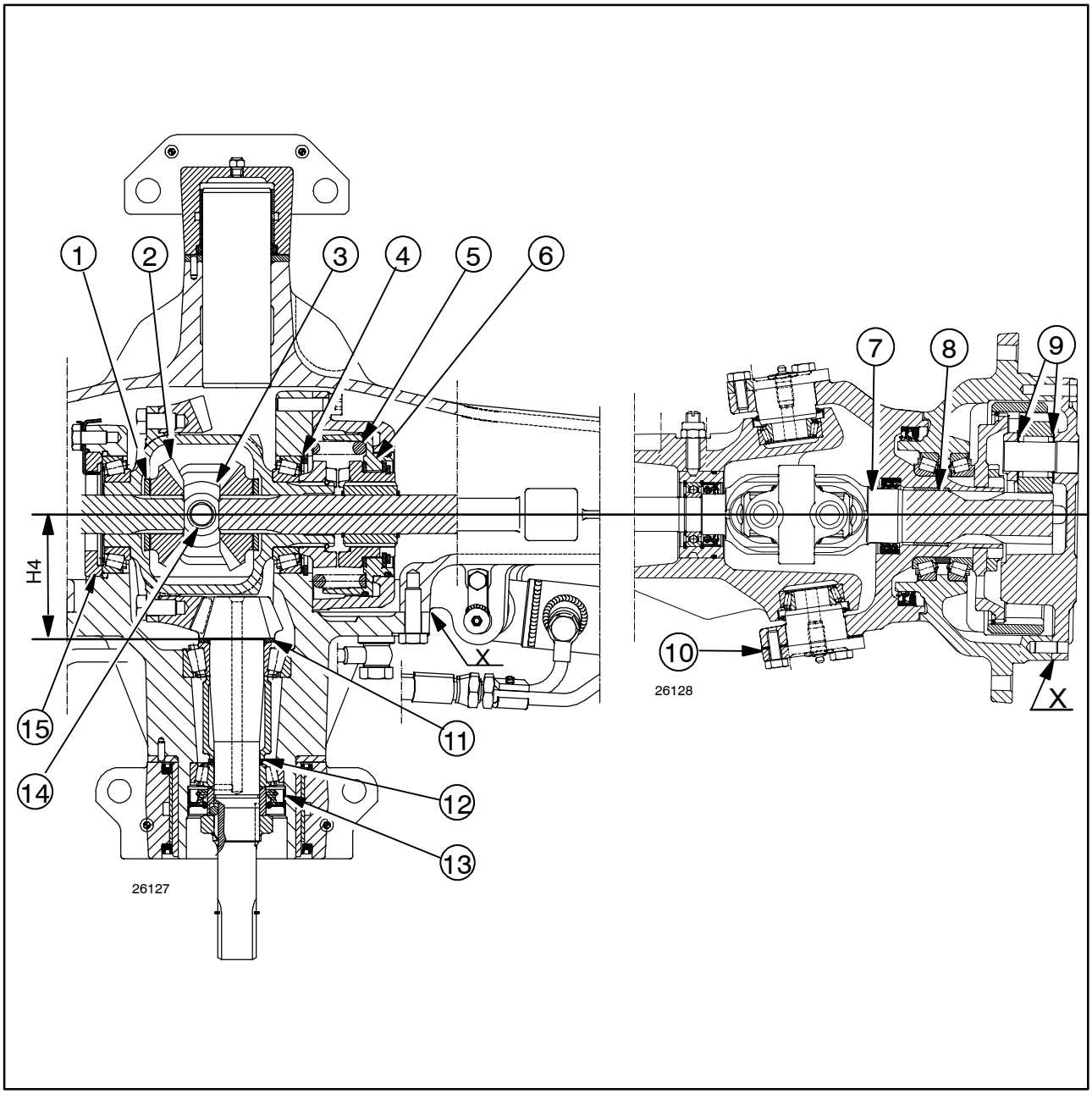


B

5

Cross-sectional view of wheel hub (fitting with brake)

A. Models TL70 and TL80.
B. Models TL90 and TL100.
C. = 0.0196 to 0.0393 in. (0.5 to 1 mm). Gasket (7) assembly clearance in seat.
1. Axle shaft.
2. Brake control pipes.
3. Brake drive piston.
4. Brake friction disk.
5. Brake disk support hub.
6. Brake piston retaining bolt (3).
7. Seal.
8. Steering knuckle adjustment plate.



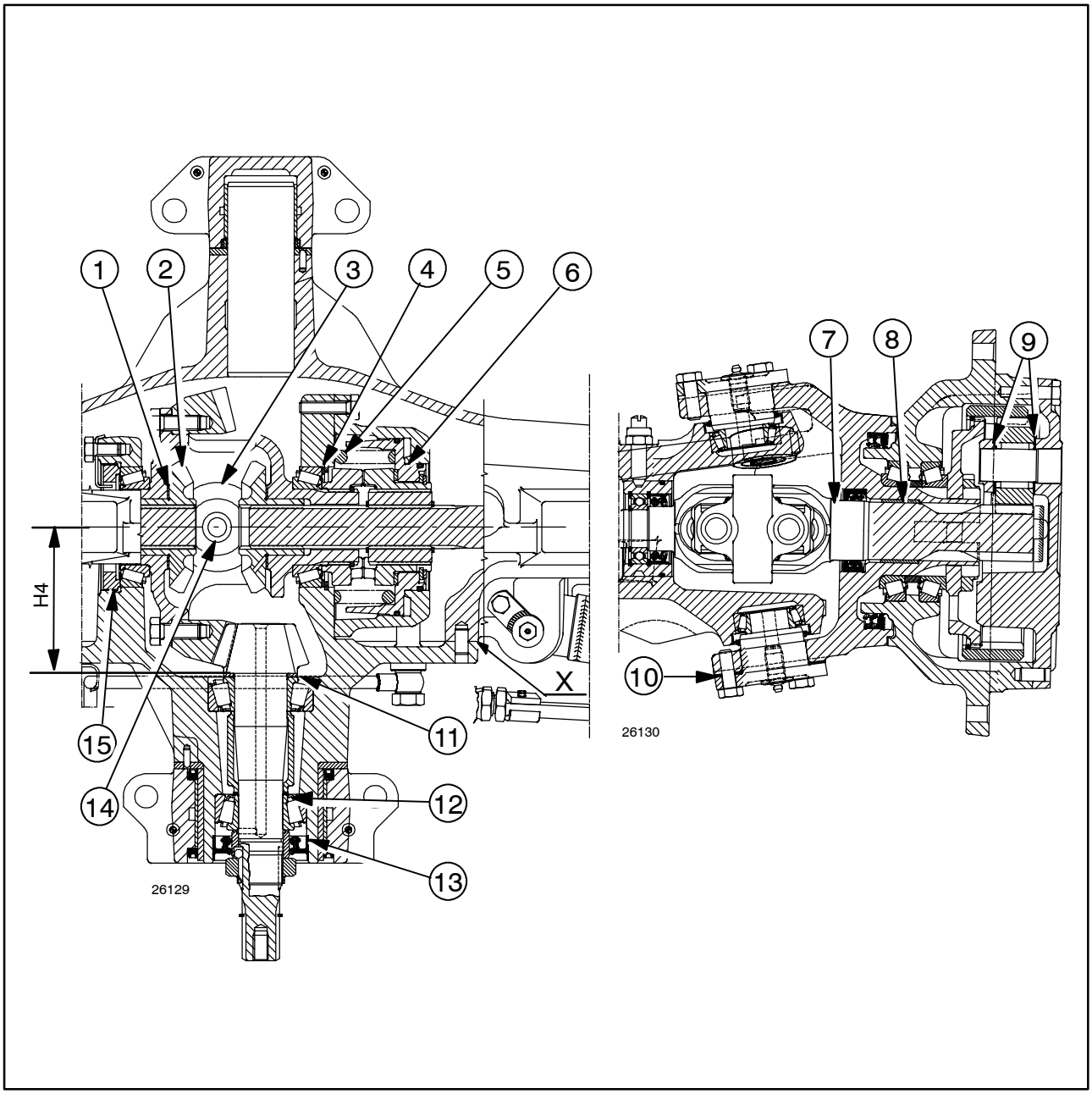
6

Cross-sectional views of front axle (models TL70 and TL80)

H_4 = 3.7401 in. (95 mm). Nominal distance between crown wheel axis and greater diameter of the pinion.

1. Thickness of sun pinion thrust washers.
2. Sun pinions.
3. Planet pinions.
4. Bevel crown wheel bearing adjustment shims.
5. Differential lock disengagement spring.
6. Differential lock control piston.
7. Axle shaft.
8. Axle-shaft bushing (7).
9. Epicyclic reduction unit driven gear shims.
10. Steering knuckle adjustment plates.
11. Thickness of bevel pinion position adjustment spacer.
12. Thickness of bevel pinion bearing adjustment spacer.
13. Seal.
14. Cross pin for planet pinions.
15. Bevel crown wheel bearing adjustment ring nut.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *as shown in fig. 106.*



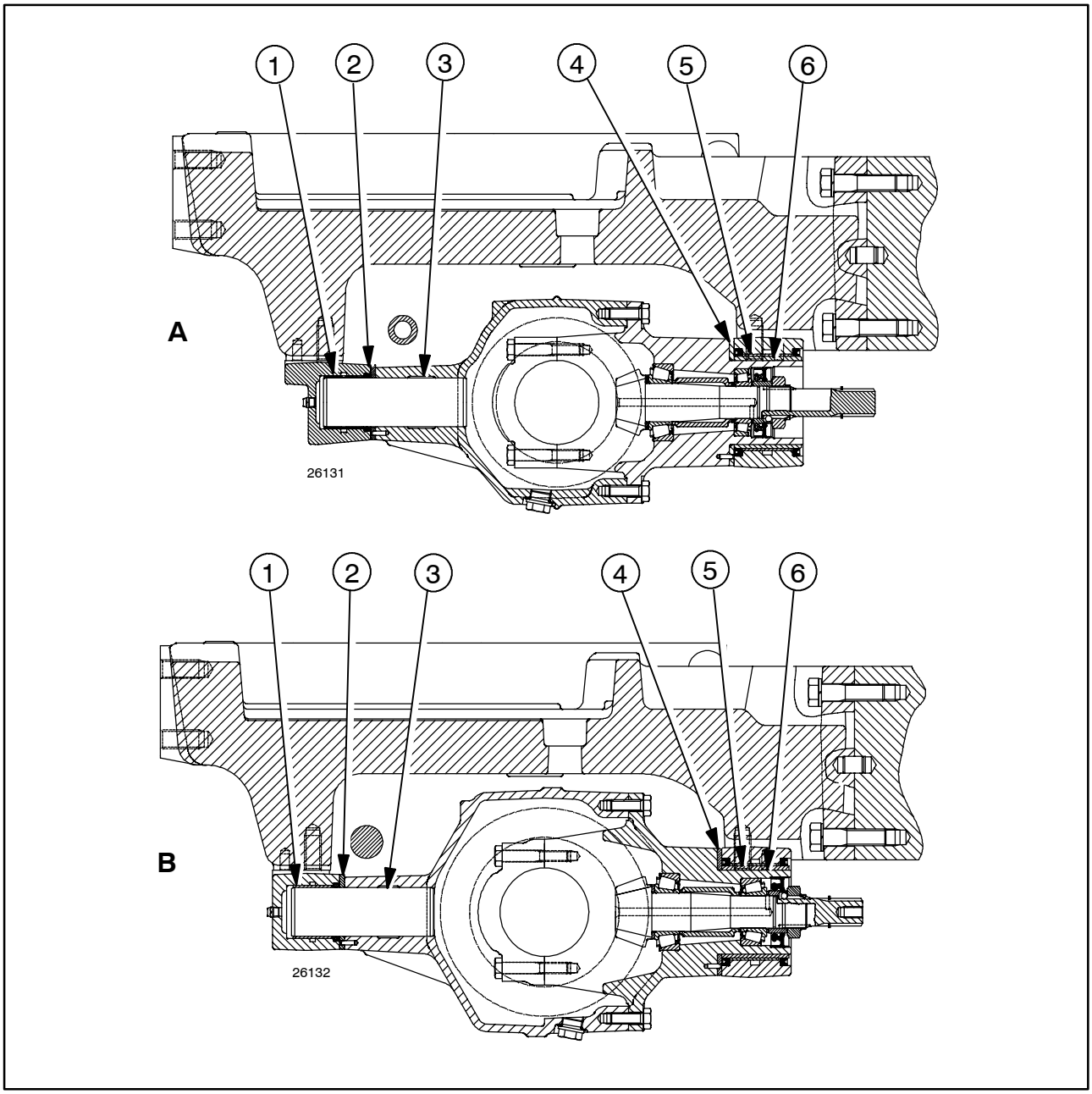
7

Cross-sectional views of front axle (models TL90 and TL100)

H_4 = 4.5275 in. (115 mm). Nominal distance between crown wheel axis and greater diameter of the pinion.

1. Thickness of sun pinion thrust washers.
2. Sun pinions.
3. Planet pinions.
4. Bevel crown wheel bearing adjustment shims.
5. Differential lock disengagement spring.
6. Differential lock control piston.
7. Axle shaft.
8. Axle-shaft bushing (7).
9. Epicyclic reduction unit driven gear shims.
10. Steering knuckle adjustment plates.
11. Thickness of bevel pinion position adjustment spacer.
12. Thickness of bevel pinion adjustment spacer.
13. Seal.
14. Cross pin for planet pinions.
15. Crown wheel bearing adjustment ring nut.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *as shown in fig. 106.*



8

Cross-sectional views of front axis pivot

A. Models TL70 and TL80.

B. Models TL90 and TL100.

1. Axle pivot front bush.

2. Front thrust washer.

3. Axle pivot front pin.

4. Rear thrust washer.

5. Rear bush installed on axle support.

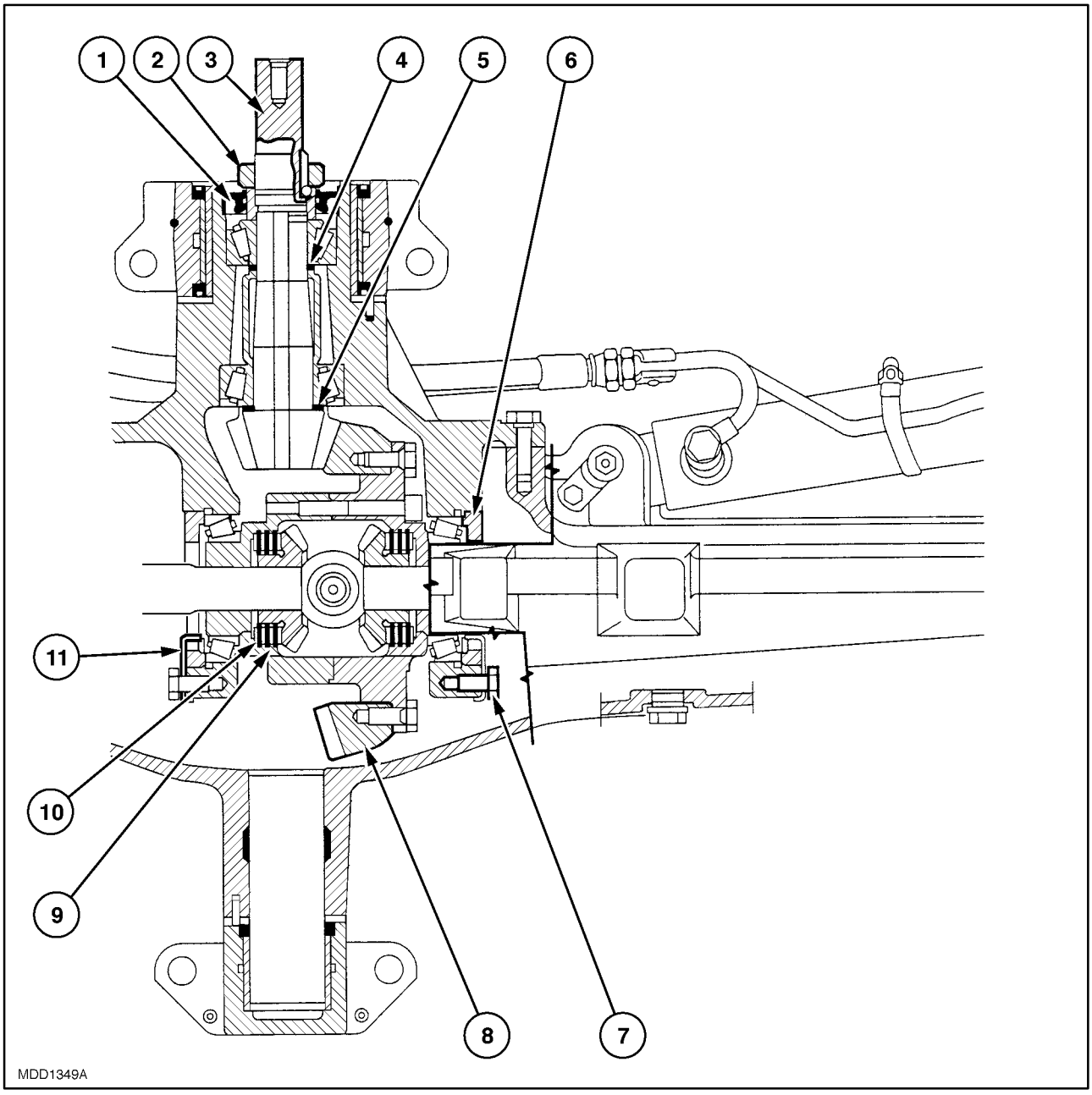
6. Rear bush installed on bevel drive-differential support.

DESCRIPTION AND OPERATION

The TL70, TL80, TL90 and TL100 tractors have their front axle pivoted at the centre with the pivot and drive gear shaft coaxial to the tractor's longitudinal axis; the drive gear shaft has no universal joints.

The differential has two planet pinions; drive is transmitted to lateral epicyclic final drive units (installed on the wheel hubs) through universal joints which do not require any maintenance.

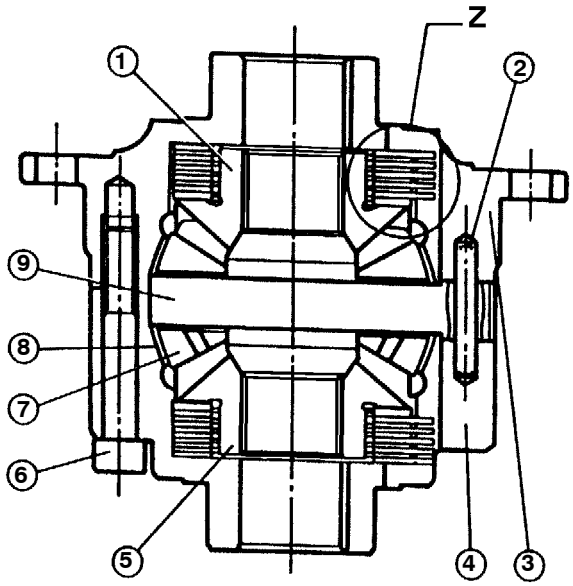
For the hydraulically controlled front gear-type differential lock, see page 15.



9

Cross-sectional view of axle with Lim-slip differential lock for TL80 TL90 TL100 NORTH AMERICAN version (on request)

1. Pinion oil seal.
2. Pinion ring nut.
3. Pinion.
4. Pinion bearing pre-load thickness.
5. Thickness of pinion position adjustment spacer.
6. Bevel crown wheel bearing adjustment ring nuts.
7. Plate retaining bolt (11).
8. Bevel crown wheel.
9. Metal disks.
10. Friction disks.
11. Ring nut locking plate (6).



MDD1350A

10

LIM - SLIP self-locking differential for TL80 TL90 TL100 NORTH AMERICAN version (on request)

LIM - SLIP SELF-LOCKING DIFFERENTIAL

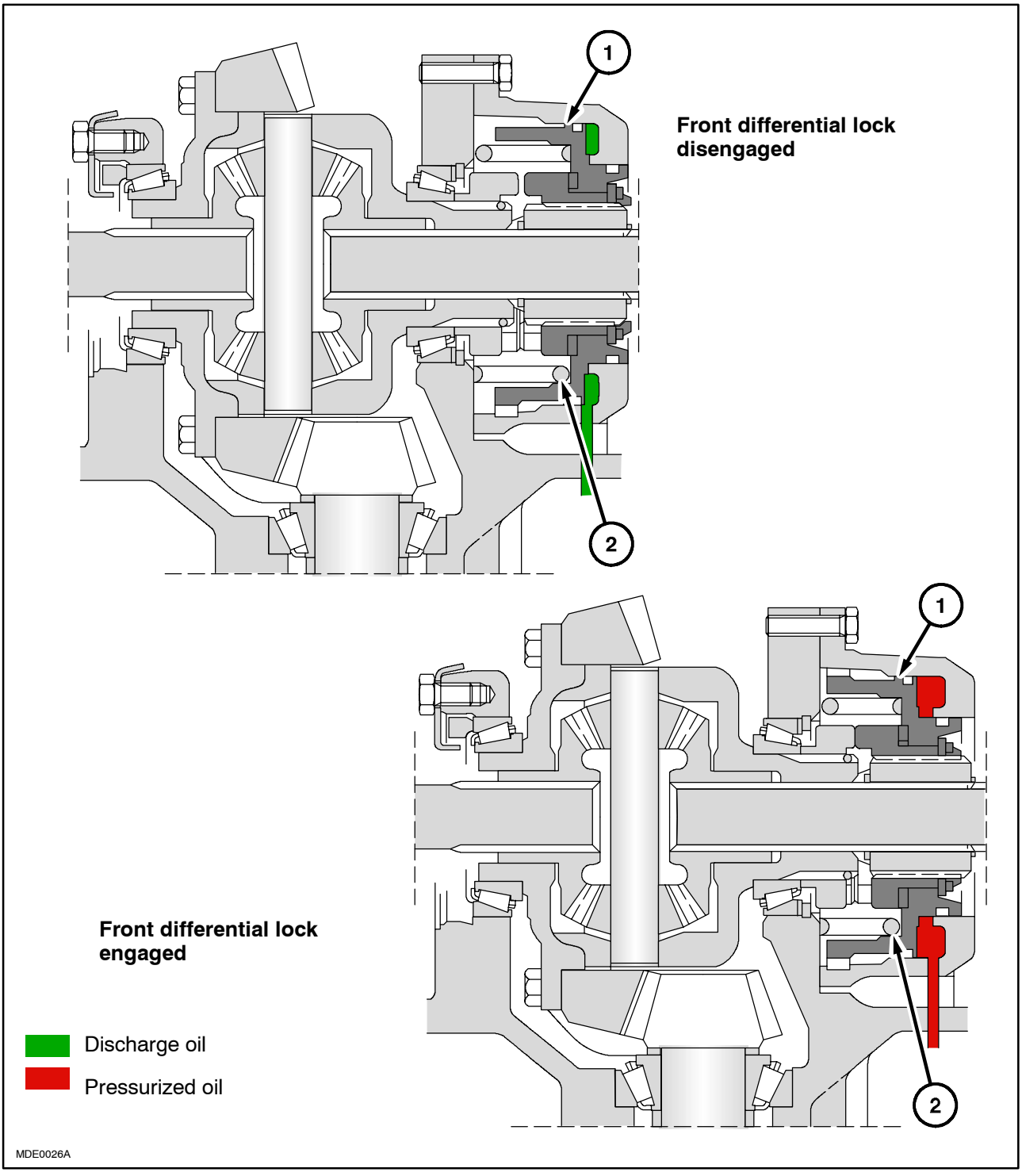
Operation

The differential with limited-slip locking (LIM - SLIP, see figs. 9 and 10) is of the two planet gear-type, provided with two multi-disk clutch assemblies fitted between the sun gears and the differential casing.

This differential lock device is totally automatic. It does not require any type of manual operation and significantly reduces (but does not completely eliminate) wheel slipping.

The difference in revolutions, between the sun gears and the differential casing when a wheel begins to slip as a result of grip loss, is impeded by clutch assemblies that are compressed by axial thrusts from the bevel drive torque transmitted to the sun gears by means of the teeth on the two planet gears.

These torque values may be different, according to the nature of the ground and the route followed by the tractor, and may vary in intensity thereby proportionally determining the axial stress on the clutches, allowing the sun gears to mesh with the differential casing which, in turn, permits the axle to overcome the unevenness of the ground.



11

FRONT DIFFERENTIAL LOCK

In rest conditions the oil inside the annular chamber of the piston (1) is static and not pressurised as the relative solenoid valve is in the discharge position (not energised).

In these conditions, the helical spring (2) keeps the teeth of the two coupling sleeves of the differential lock apart.

By operating the relative switch on the control panel, the solenoid valve opens to allow the oil sent from the pump to enter the annular chamber of the control piston (1), overcome the resistance of the spring (2) and thus cause the teeth of the coupling sleeves to mesh and engage the differential lock.

FRONT AXLE HYDRAULIC DIFFERENTIAL LOCK TROUBLESHOOTING

Problems	Possible Causes	Solutions
The differential lock fails to engage.	**1.** Transmission oil level insufficient.	Top up oil level.
	2. Clogged oil filter.	Replace filter.
	3. Hydraulic pump faulty.	Overhaul or replace pump.
	4. Differential lock control switch faulty.	Replace switch.
	5. No power at solenoid valve: connections loose or damaged, contactor defective.	Check electrical connections and replace defective parts.
	6. Differential lock control solenoid valve jammed in discharge position.	Overhaul or replace solenoid valve.
	7. Oil leakage through seals, leading to drop in pressure: cylinder piston or feed pipe seals.	Replace all defective seals.
Differential lock fails to disengage.	**1.** Differential lock solenoid valve jammed in delivery position.	Overhaul or replace solenoid valve.
	2. Differential lock release spring broken.	Replace spring.
	3. No power at solenoid valve: connections loose or damaged, contactor defective.	Check electrical connections and replace defective parts.
With differential lock engaged and the control switch in position 3. when the lift arms are raised with the LIFT-O-MATIC the differential lock fails to disengage.	**1.** Differential lock control switch (connected to LIFT-O-MATIC device) defective.	Replace switch.
With differential lock engaged, lock fails to release when brake pedals are pressed.	**1.** Differential lock control switch (connected to brake pump) defective.	Replace switch.

Op. 25 100 30
FRONT AXLE R.I.

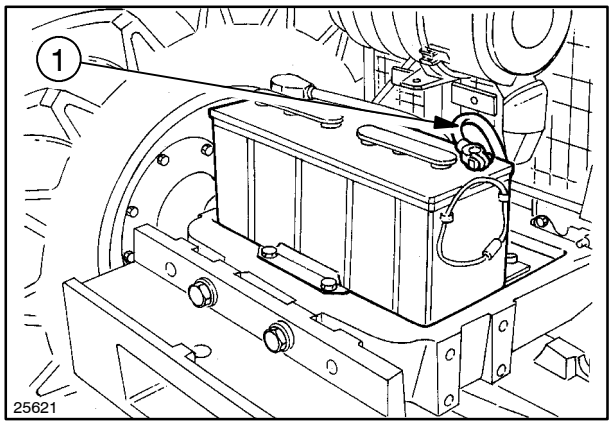
DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

Proceed as follows:

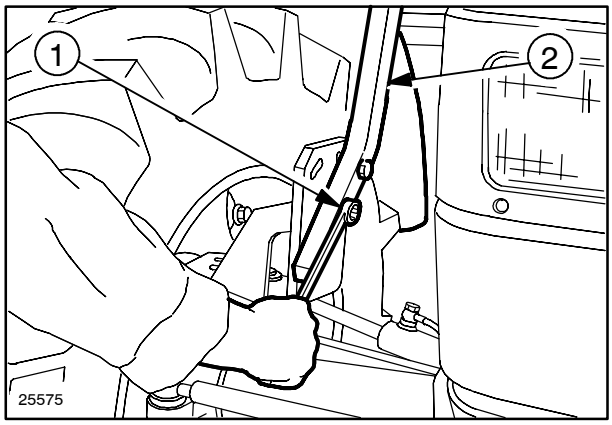
NOTE: *The front axle assembly can be removed from the tractor either with or without previously removing the drive shaft. The description below refers to removal of the front axle with the drive shaft installed on the tractor. For removal of the drive shaft refer to* ***section 23.***

1. Disconnect the battery negative cable (1).



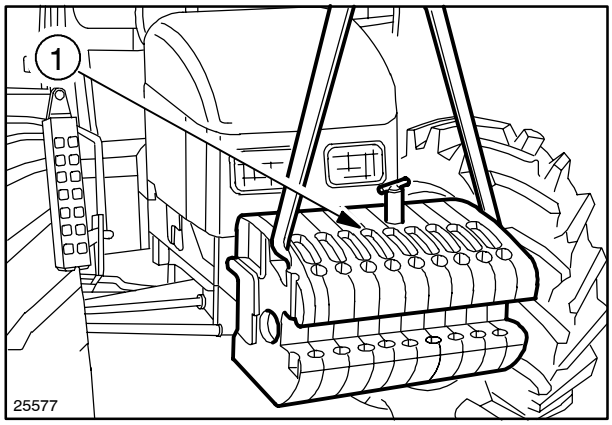
12

2. Unscrew bolts (1) and remove the front mudguard supports (2).



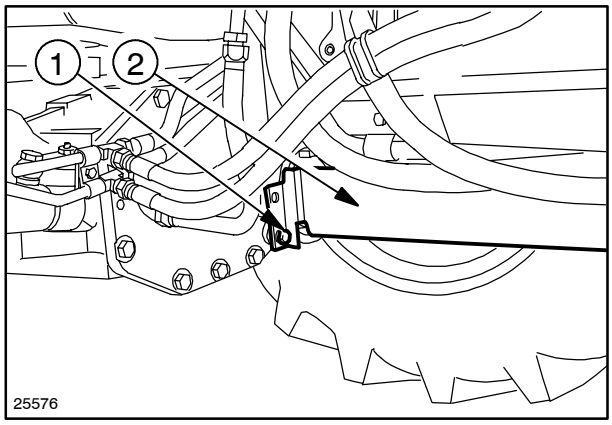
13

3. Remove the split pins, lock pins and front ballast (1).



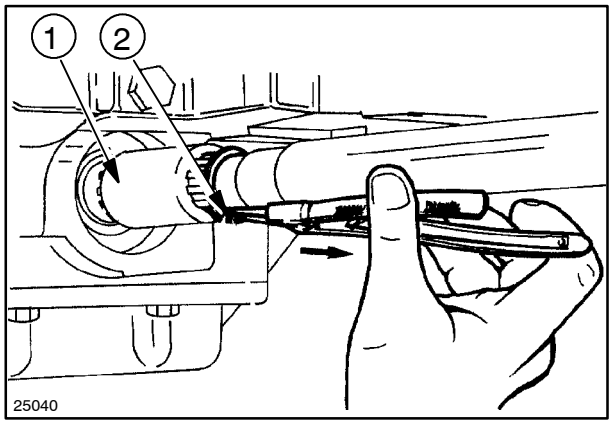
14

4. Take out the bolts (1) and remove the drive gear shaft guard (2).



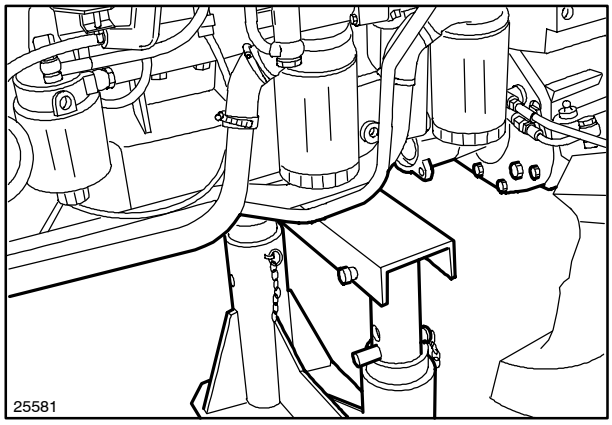
15

5. Remove the circlip (2) and move the sleeve (1) in the direction indicated by the arrow until it is released from the groove on the drive.
6. Attach the front axle to a hoist using two nylon slings.



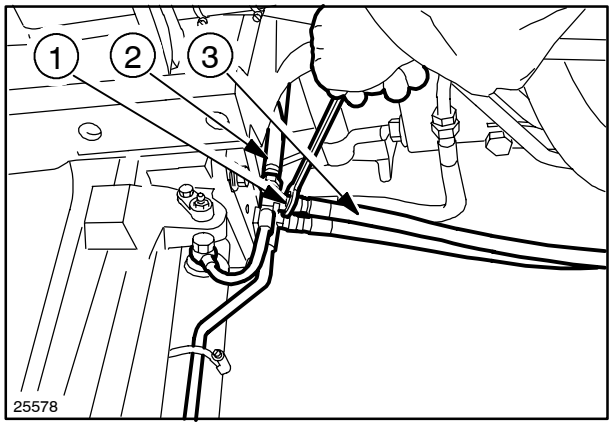
16

7. Raise the tractor and position a fixed stand under the engine sump.



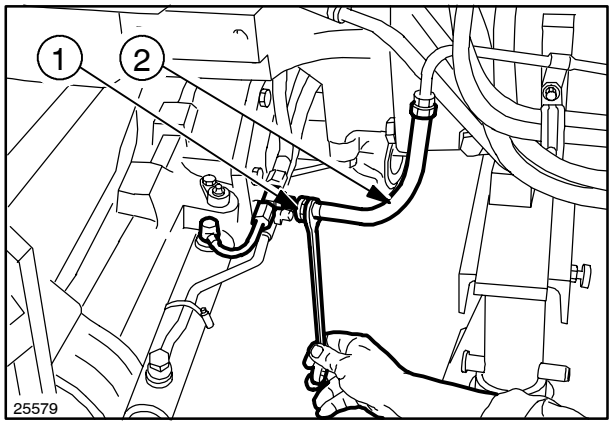
17

8. Remove the unions (1) on the power steering cylinder rigid pipes (2) and disconnect the two hoses (3).



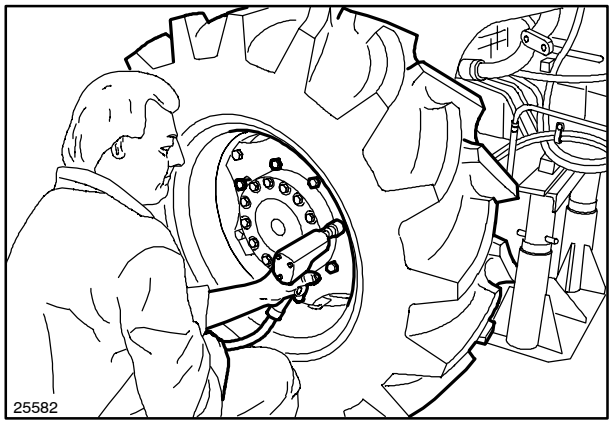
18

9. Remove the front differential lock union (1) and the hose (2).



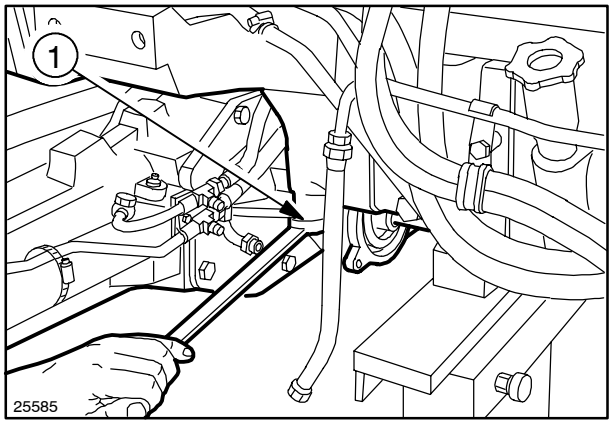
19

10. Unscrew the retaining bolts and remove the front wheels.



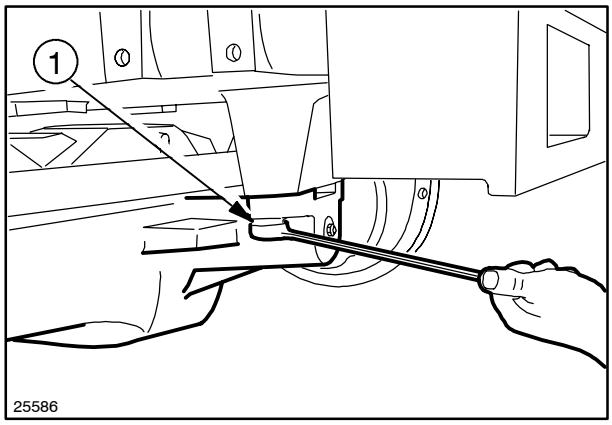
20

11. Take out the front axle rear support retaining bolts (1).



21

12. Take out the front axle front support retaining bolts (1).



22

13. Using the hoist and the two nylon slings, one on each side, detach the front axle.

14. To refit the front axle on the tractor, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

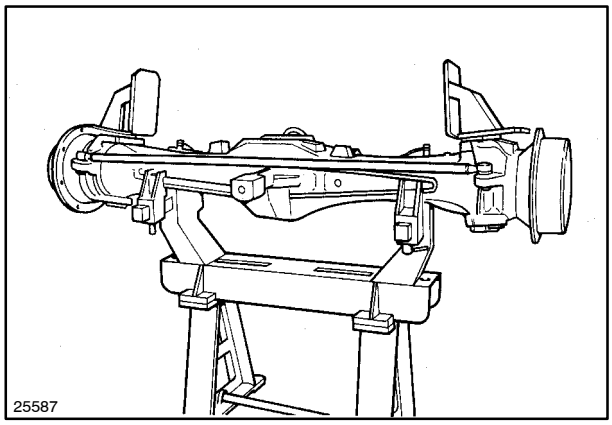
- Position the axle, tighten the front and rear supports to the relative support.
- Reconnect the differential lock pipe and the power steering pipes.
- Fit the front wheels.
- Using the hoist, raise the front part of the tractor.
- Extract the fixed stand.
- Remove the nylon slings from the axle.
- Connect the drive shaft and position the guard.
- Refit the two front mudguards.
- Attach a nylon sling to the front ballasting, fit and secure in position with the lock rod.
- Reconnect the battery negative lead.
- Respect the tightening torque values indicated on page 4.

Op. 25 100 38
FRONT AXLE D.A.

CAUTION

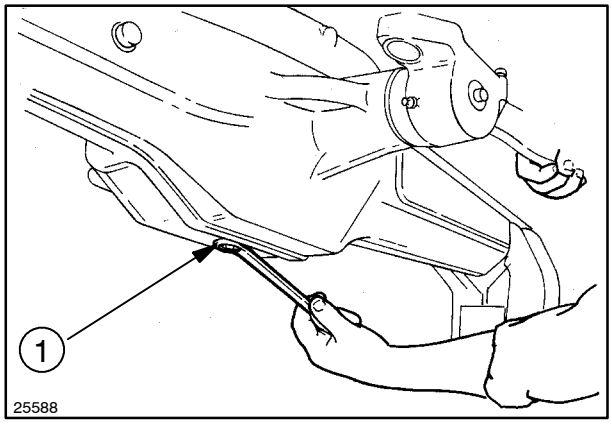
Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

NOTE: *Front axle overhaul operations must be carried out on stand no.* ***380000251****.*



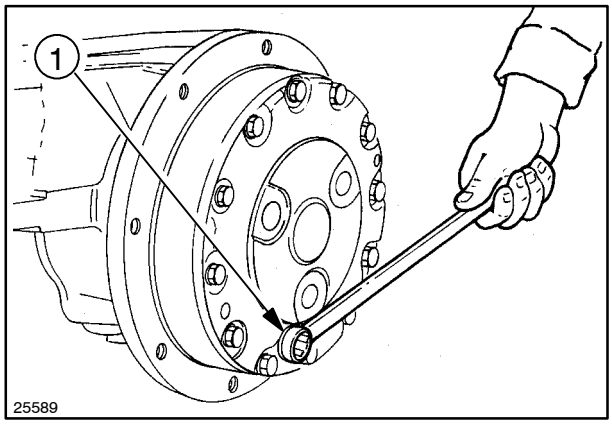
23

1. Remove the plug (1) and drain the oil from the axle casing.



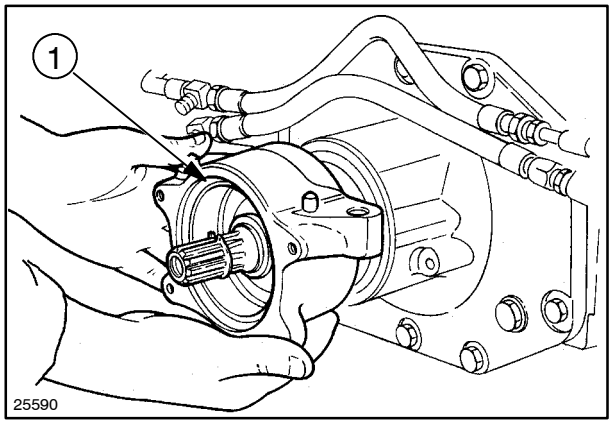
24

2. Remove the plug (1) from the left-hand epicyclic final drive casing; repeat the same operation on the right-hand casing.



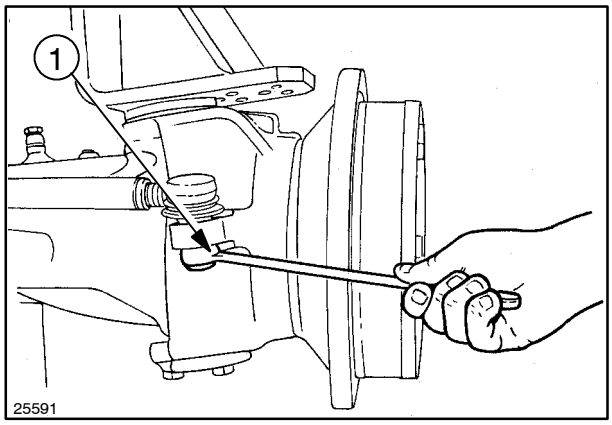
25

3. Remove the front axle rear support (1); remove the front support and washer.



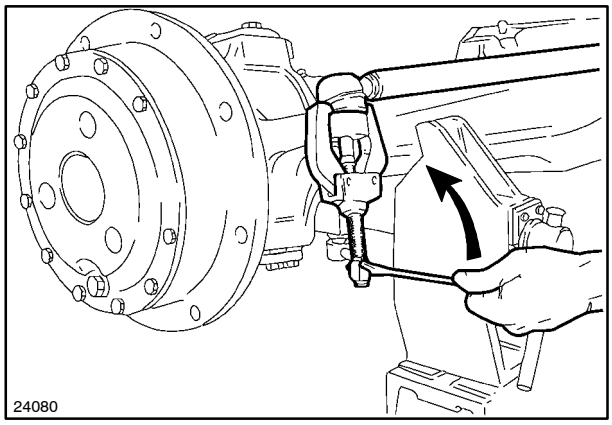
26

4. Unscrew the two nuts (1) locking the track rod.



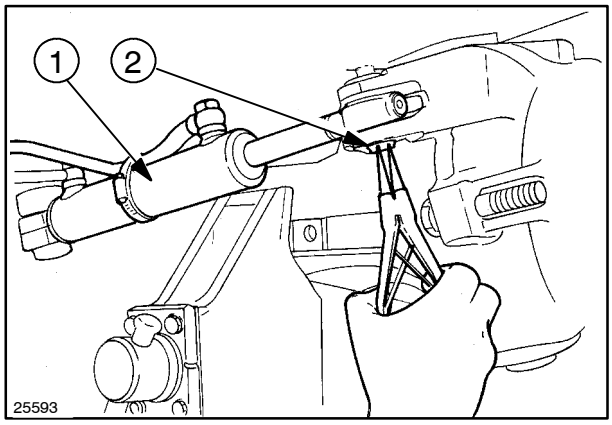
27

5. Using an extractor, extract the pins from the seats on the stub axle housing, removing the track rod.



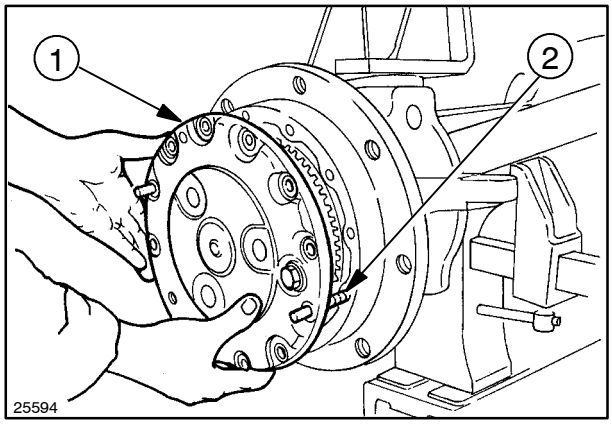
28

6. Remove the circlips (2) from the cylinder rod pivot pins, unscrew the cylinder (1) pin retaining bolts, extract the pins and remove the two cylinders. Remove the four pins, washers, spacers and cylinders, complete with pipes.



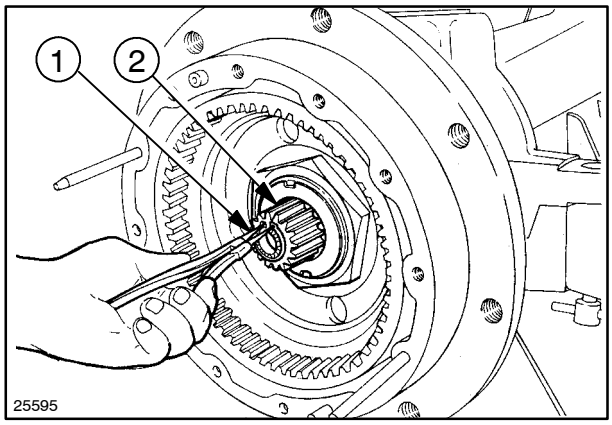
29

7. Take out the bolts (1) securing the left-hand final drive cover. Tighten two pins (2) and, using an extracting tool screwed into the oil drainage plug hole, remove the cover (1).



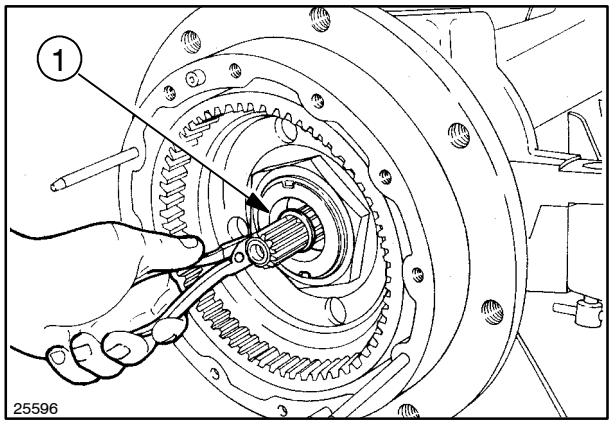
30

8. Remove the circlip (1) retaining the driving gear (2) and then remove this too.



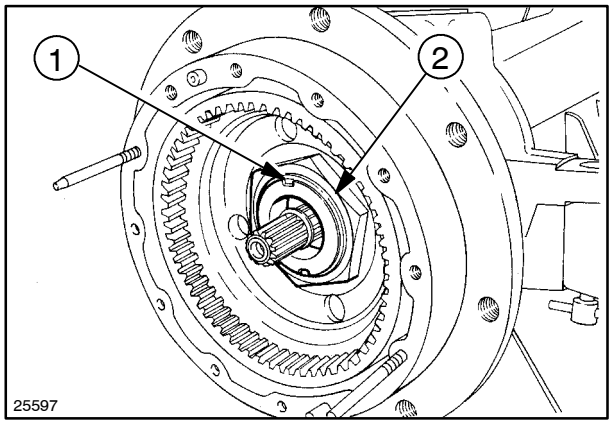
31

9. Remove the circlip (1) retaining the driving gear (2, fig. 31).



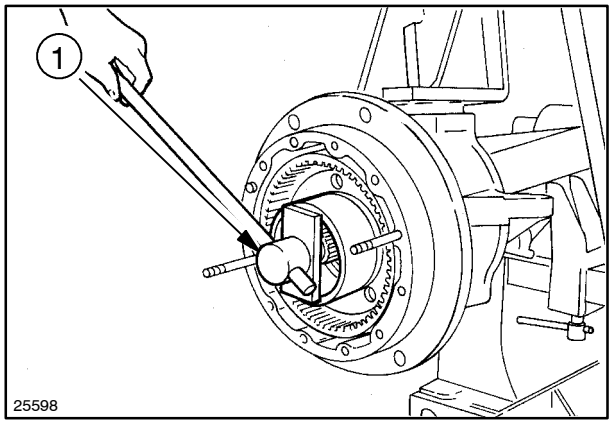
32

10. Remove the notching (1) on the ring nut (2) retaining the wheel hub bearings.



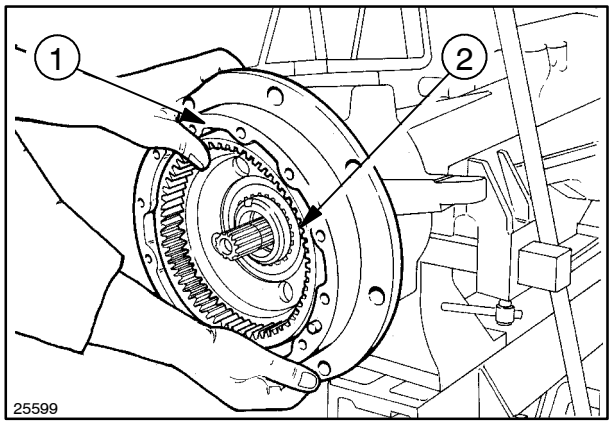
33

11. Remove the ring nut retaining the wheel hub bearings using the wrench **380000295** (1) for models TL70 and TL80 or with the wrench **380000269** (1) for models TL90 and TL100.



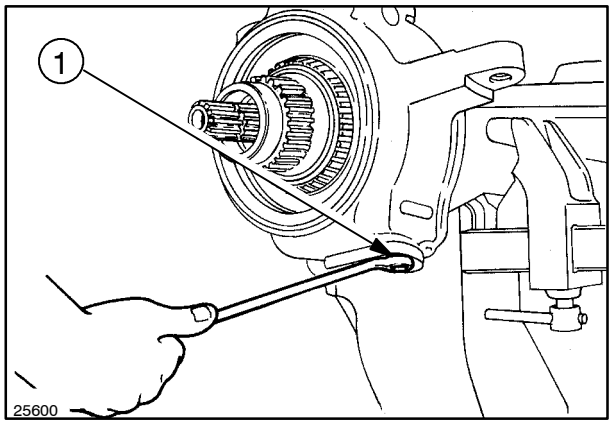
34

12. Remove the wheel hub (1) together with the epicyclic crown (2) and recover the disassembled parts.



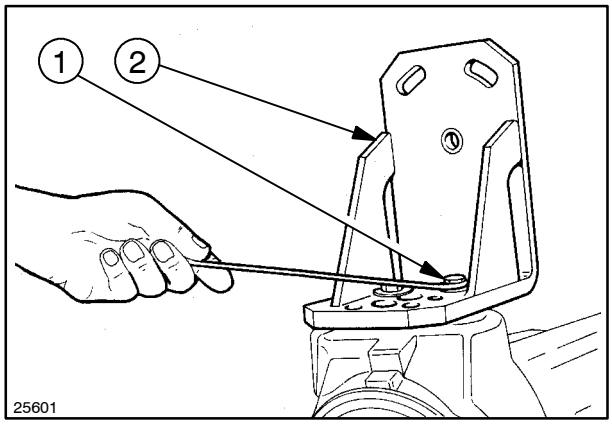
35

13. Take out the three bolts (1) retaining the stub axle bottom pin, remove the bottom pivot pin and the associated adjustment shims.



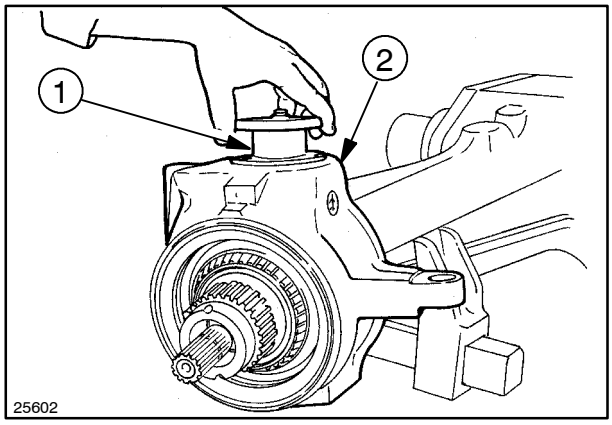
36

14. Take out the three bolts (1) retaining the mudguard support (2).



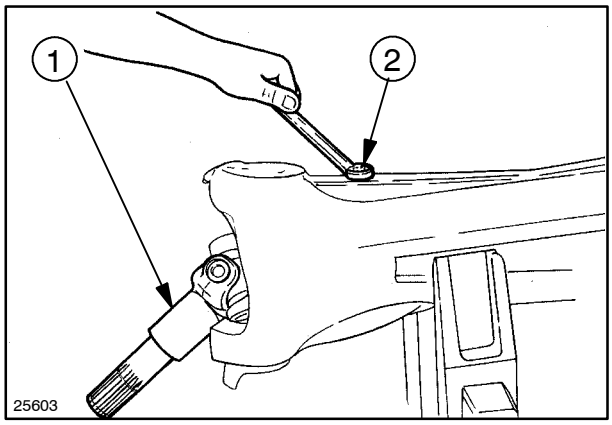
37

15. Extract the upper pivot pin (1) and remove the stub axle (2). Recover all disassembled parts.



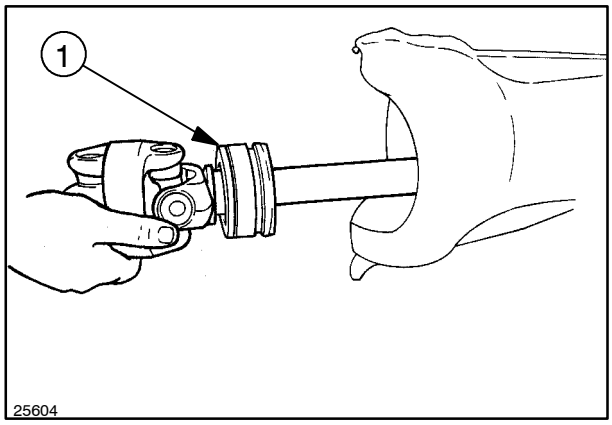
38

16. Take out the bolt (2) retaining the axle-shaft (1).



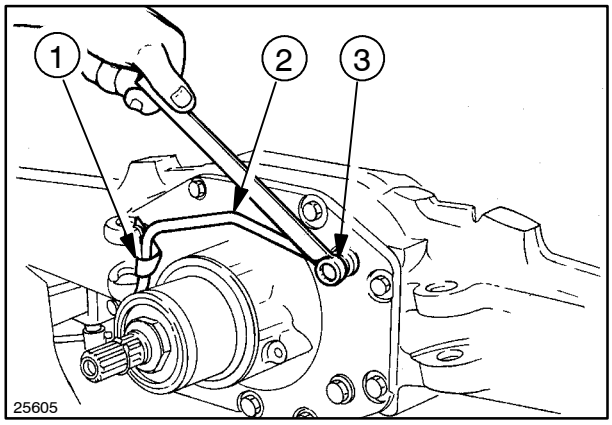
39

17. Using a crowbar, remove the axle shaft (1).
18. To disassemble the right-hand final drive follow the operations carried out for left-hand final drive disassembly, from operation no. 7 to operation no. 17.



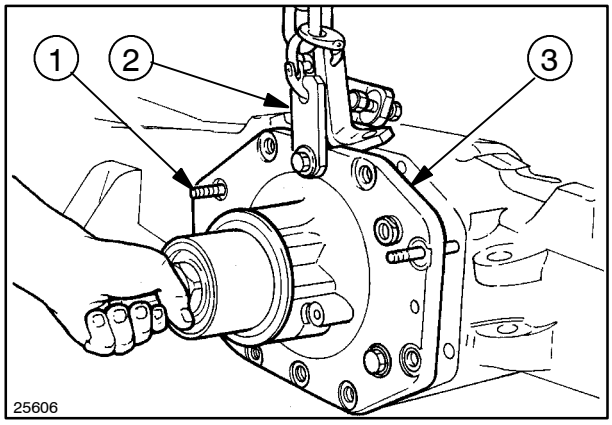
40

19. Take off the bracket (1), unscrew the union (3) and remove the differential lock control rigid pipe (2).



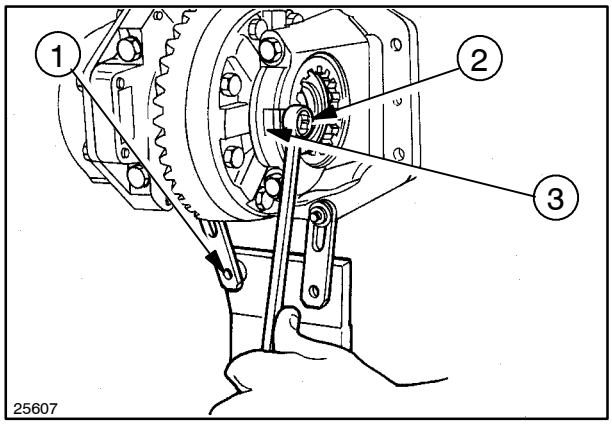
41

20. Unscrew the two bevel drive-differential support retaining bolts from the axle casing, screw on the two pins (1). Remove the remaining bolts and the bevel drive-differential support, attach a chain (2) and put the hoist under strain. Remove the bevel drive-differential support (3) from the axle casing.



42

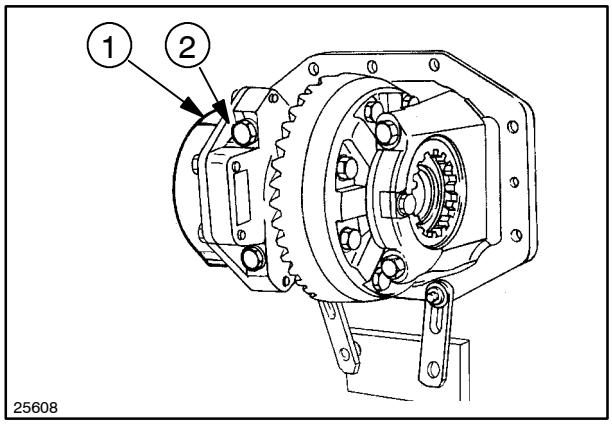
21. Fit tool **380000255** (1) in the vice on a work bench, lock the bevel drive-differential support in the tool and remove the chain.
22. Take out the bolt (2) and remove the plate locking the ring nut (3). Remove the differential lock control internal pipe.



43

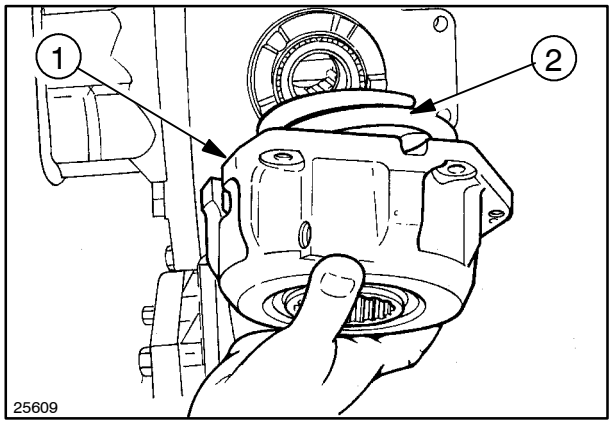
23. Remove the upper (1) and lower (2) bolts of the external differential lock bell housing and install two bolts (minimum length 2.7559 in. (70 mm) in their place. Gradually unscrew the remaining bell housing bolts so as to allow the gradual extension of the differential lock release spring.

NOTE: *It is necessary to install two bolts with a minimum length of 2.7559 in. (70 mm), because the normal bell housing bolts are not long enough to allow the spring to extend to its full free length.*



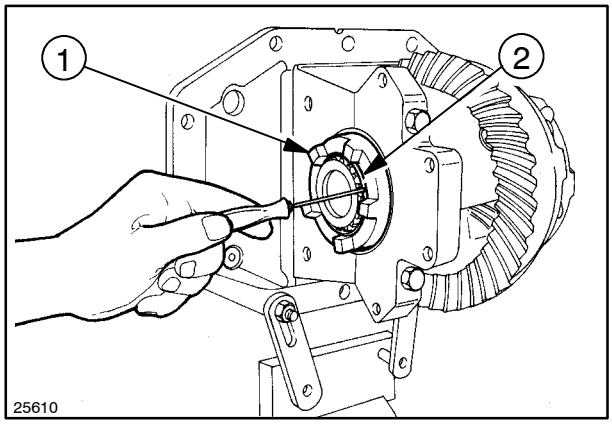
44

24. Unscrew the two 2.7559 in. (70 mm) bolts last of all, remove the bell (1), the spring (2) and differential lock control piston.



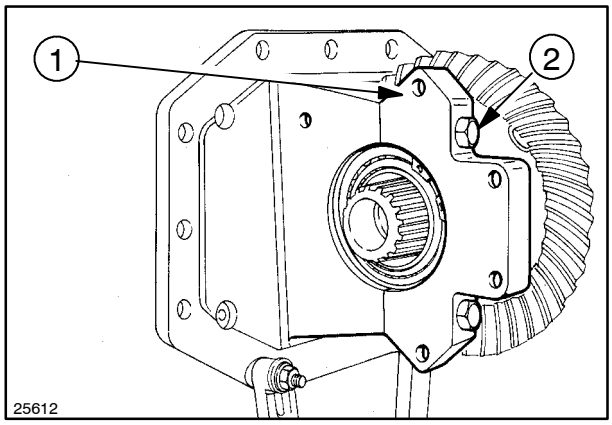
45

25. Using a screwdriver, remove the circlip (2) and the differential lock sleeve.



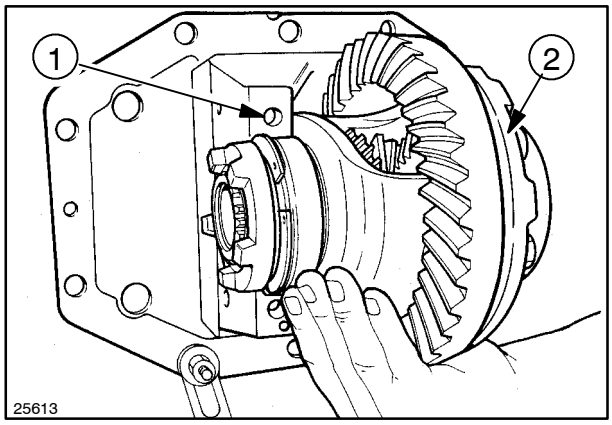
46

26. Take out the bolts (2) securing the caps (1) supporting the bevel crown-differential and remove them.



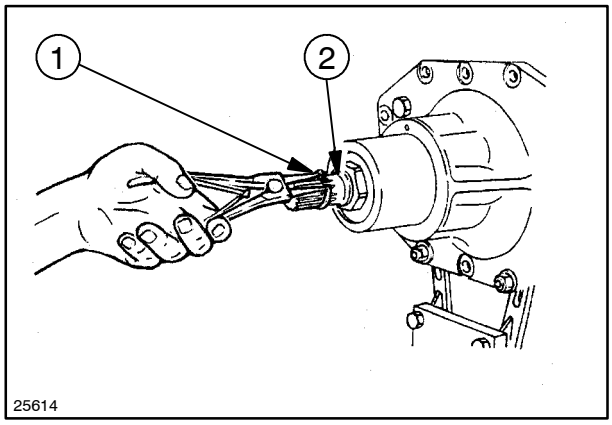
47

27. Remove the crown wheel-differential unit (2) from the casing (1).



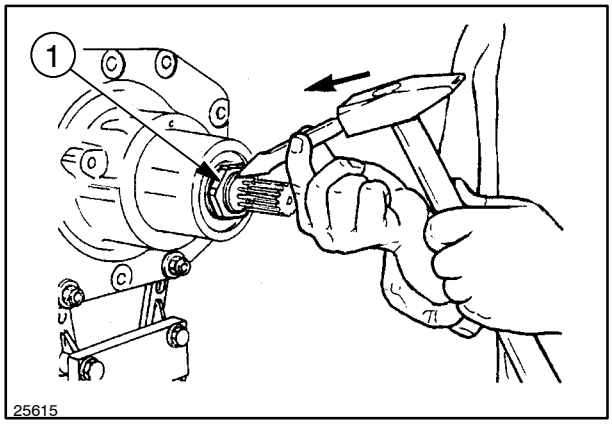
48

28. Remove the circlip (1) from the splined shaft (2).



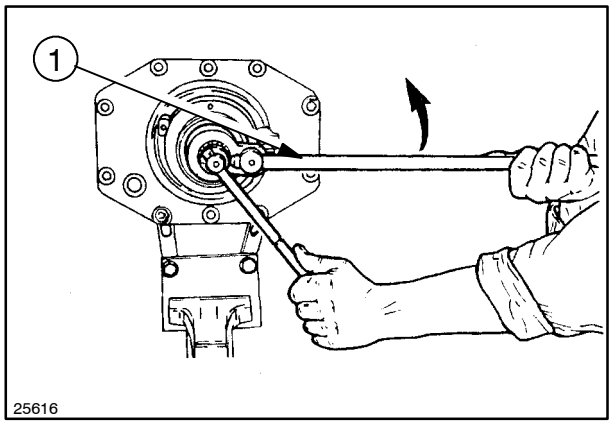
49

29. Straighten out the notching on the splined shaft lock nut (1).



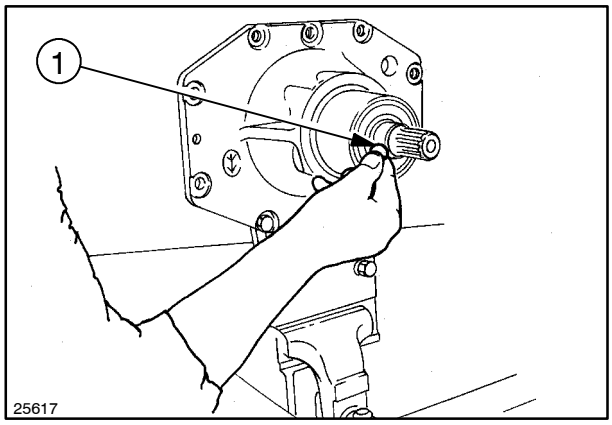
50

30. Unscrew the nut with wrench **380000268** (1), keeping the bevel pinion shaft locked with wrench **380000257**.



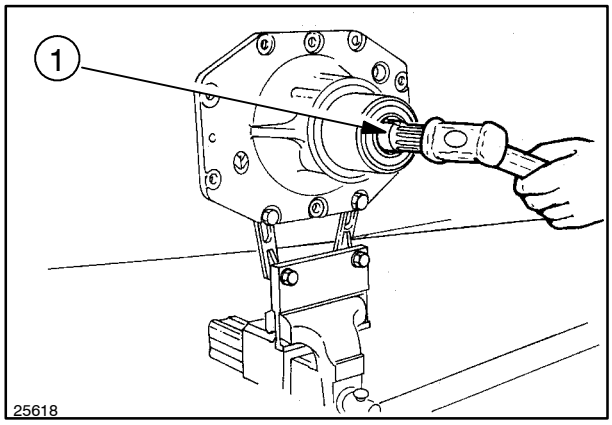
51

31. Remove the splined shaft stop ball (1).



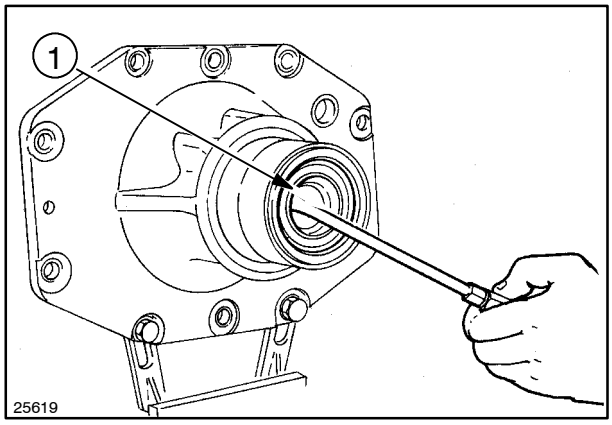
52

32. Acting on the rear part, extract the bevel pinion shaft (1) and remove the spacer, adjustment shims and the bearing.



53

33. Using a screwdriver, detach and remove the dust seal, seal (1) and rear bearing.



54

34. To assemble the front axle, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

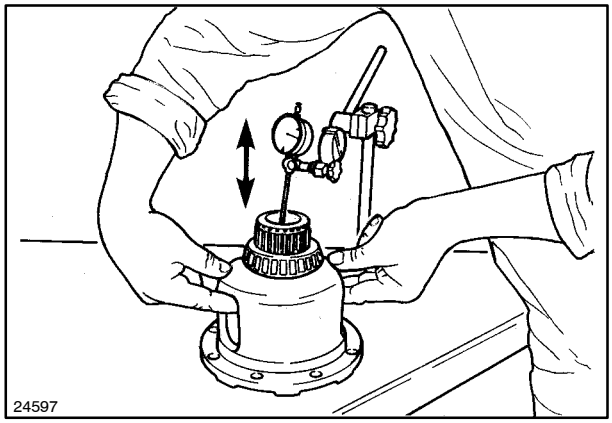
- For the correct orientation of the various components, refer to the illustrations in figs. 5 to 10.
- Respect the tightening torques prescribed on page 4.
- Carry out the adjustments described from page 43 to page 51.
- Fit the rear bearing, seal, dust seal, adjustment shims, spacer and bevel pinion shaft, complete with front bearing.
- Position the stop ball, tighten and secure the bevel pinion nut, then position the circlip.
- Assemble the crown wheel–differential unit and support caps and tighten the relative screws.
- Assemble the differential lock sleeve and relative stop ring.
- Assemble the differential lock control piston, spring, bell housing and tighten the relative bolts, then fit the ring nut locking plate and differential lock internal pipe.
- Reconnect the bevel drive–differential support to the front axle casing and fit the differential lock external pipe.
- Fit the axle shaft and screw.
- Fit the stub axle, the adjusting shims, lower and upper pivot pins, mudguard support and screws.
- Fit the wheel hub, final drive crown wheel and ring nut and tighten to the prescribed torque whilst rotating the hub to settle the bearings.
- Fit the snap rings, drive gear and final drive cover.
- Fit the pins, washers, spacers and steering control cylinder.
- Fit the track rod, front and rear supports and the oil drainage plugs.

Op. 25 102 24
FRONT AXLE DIFFERENTIAL
Overhaul

In case of differential assembly overhaul it is necessary to adjust the backlash between the teeth of the sun and planet pinions.

Proceed as follows:

1. Thoroughly clean the components of the differential to remove any traces of oil that would otherwise prevent accurate backlash measurement.
2. Fit the two sun gears without thrust washers on the differential casing.
3. Fit the planet pinions complete with thrust washers and pins and screw down the pin retaining bolts by a few turns to hold the pins in place.
4. Position a dial gauge on the differential housing.
5. Move the left-hand sun gear to bring it into full contact with the planet pinion and then push it up against the differential housing, reading the endfloat (G_s) on the micrometer.

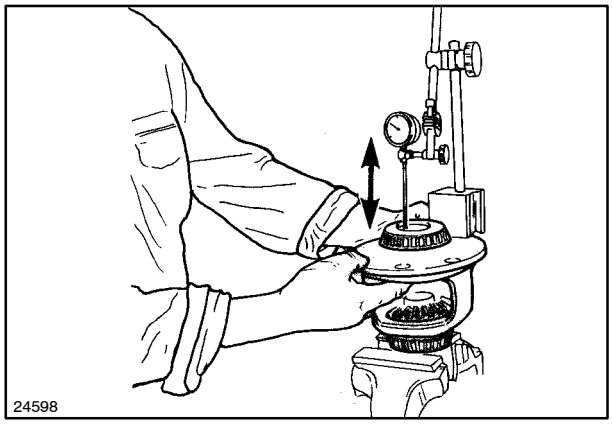


55

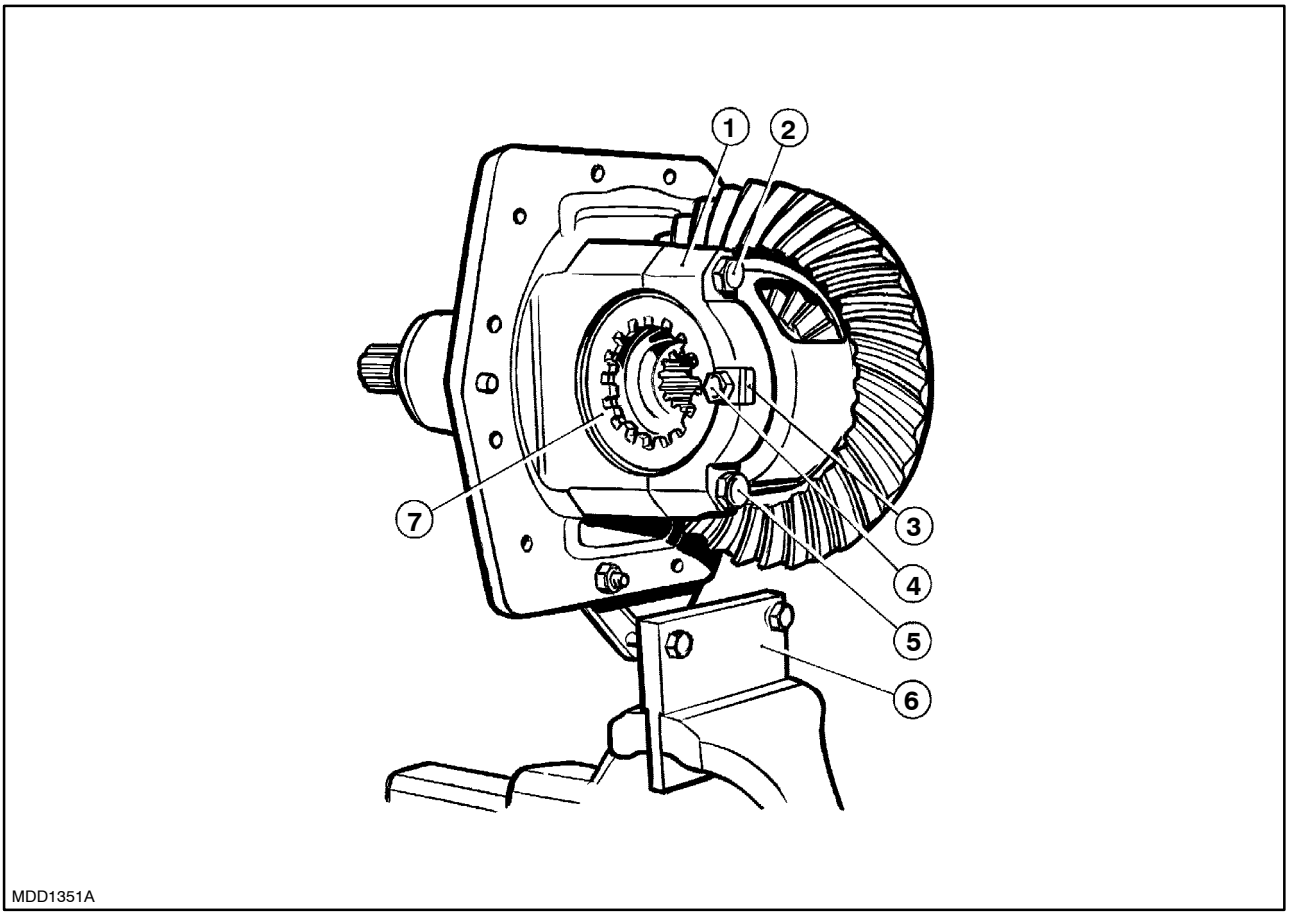
6. Repeat the above operations to measure the endfloat on the right-hand sun gear (G_d).

- The endfloat must be **0.0098 in. (0.25 mm).**
- Therefore the shims to be inserted in the differential housing are given by:
- **$S_s = G_s$ - 0.0098 in. (0.25 mm)** for the left-hand sun gear;
- **$S_d = G_d$ - 0.0098 in. (0.25 mm)** for the right-hand sun gear.

7. Install shims as near as possible to the calculated value and, using a dial gauge and following the previously described procedure, check that the endfloat of the left- and right-hand sun gears is approximately 0.0098 in. (0.25 mm).



56



57

Front axle differential with LIM - SLIP for TL80, TL90 and TL100 NORTH AMERICAN version (on request)

Op. 25 102 27
FRONT AXLE DIFFERENTIAL WITH LIM-SLIP UNIT
Overhaul

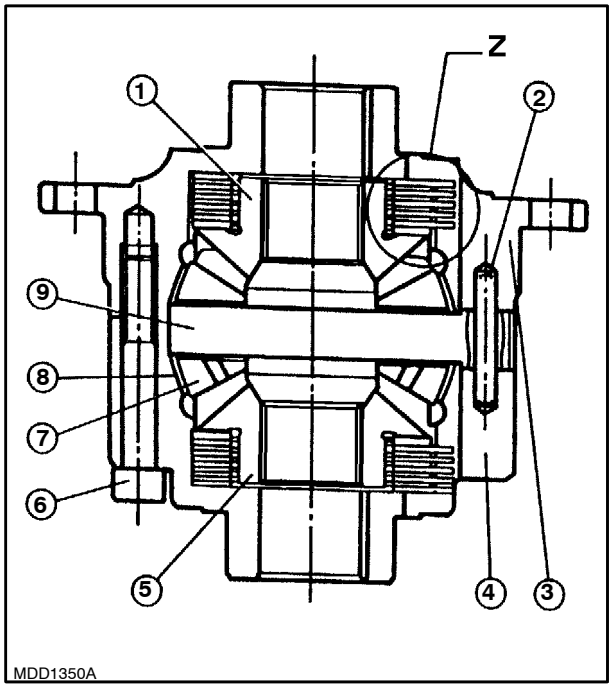
⚠ CAUTION ⚠

Handle all parts carefully.
Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Remove the bevel drive-differential casing assembly from the front axle, attach to support **380 000 255** (6), lock in a vice and proceed with disassembly operations as follows.
2. Take out the bolts (4) and the plates (3) retaining the right- and left-hand ring nuts (7).
3. Check that the right- and left-hand caps (1) are clearly marked, so as not to interchange the parts during assembly operations.
4. Remove the right- and left-hand bearing adjustment ring nuts (7) from the crown wheel.
5. Take out the bolts (2) and caps (1) and separate the bevel crown wheel from the bevel pinion support.
6. If necessary, take out the retaining bolts (C1, page 4) and the bevel crown wheel.

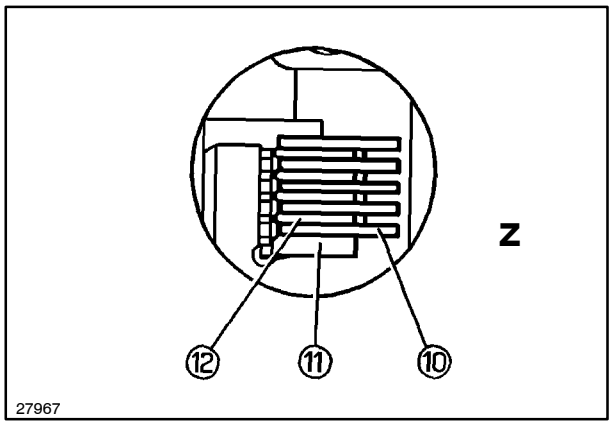
Disassemble the LIM-SLIP self-locking differential lock as follows.

7. Remove the retaining bolts (6) from the differential half-casings.
8. Remove the differential pin (9), complete with planet gears (7), thrust washers (8) and pin (2) from the half-casing (4).
9. Remove the sun gear (5), friction disk (11, fig. 59), metal disks (10) and friction disks (12).
10. Remove the sun gear (1), friction disk (11), metal disks (10) and the friction disks (12) from the half-casing (3).
11. Check the wear on the metal disks (10) and the friction disks (11 and 12, see table below), replacing parts that show signs of wear.
12. Proceed with self-locking differential assembly operations, carrying out the previously described operations in reverse order, apply LOCTITE 270 to the threads on the screws (6) and tighten to a torque value of 50 Nm (5.1 kgm).
13. Refit the bevel crown wheel (if previously disassembled) on the half-casing (3), tightening the bolts (C_1, page 4) to a torque value of 113 Nm (11.5 kgm).
14. Check the rolling torque of the bevel pinion, as indicated on page 48.
15. Assemble the bevel crown wheel, complete with LIM-SLIP self-locking differential, on the bevel drive support, remembering to fit the previously marked bevel crown wheel bearing support caps in the correct order and assemble and adjust the bevel crown wheel bearings as indicated on page 49.



58

LIM-SLIP self-locking differential



59

Friction parts detail

LIM-SLIP self-locking differential friction disks				
Item no.	Description	Amount	Thickness in. (mm)	Maximum wear per disk in. (mm)
10	Metal disk	10	0.0590 (1.5)	-
11	Friction disk	2	0.1102 (2.8)	0.0039 (0.10)
12	Friction disk	8	0.0629 (1.6)	0.0059 (0.15)

Op. 25 104 34
FRONT DIFFERENTIAL LOCK CLUTCH ASSEMBLY
Overhaul

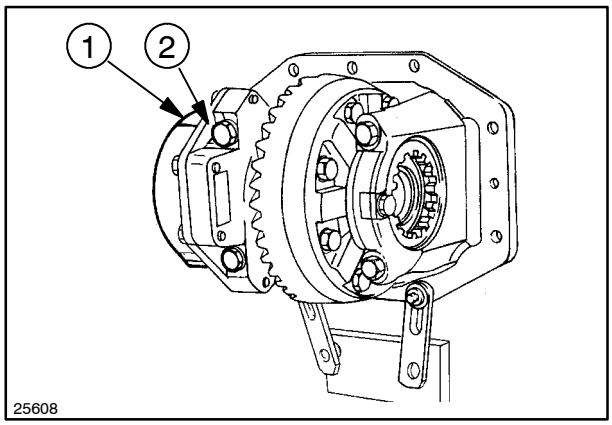
CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

Position the bevel crown wheel-differential assembly on the support **380000255** and proceed as follows:

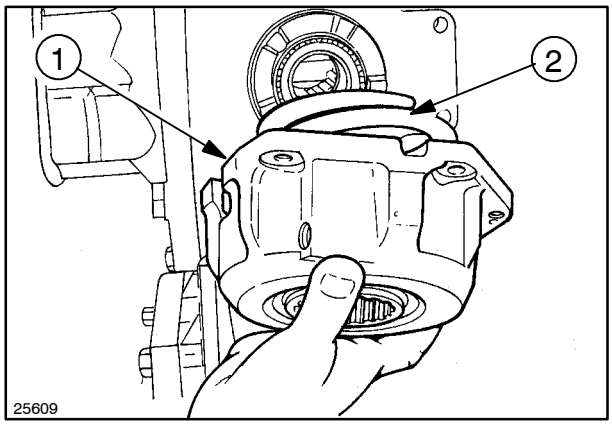
1. Remove the differential lock control internal pipe.
2. Remove the upper (2) and lower bolts of the external differential lock bell housing (1) and install two bolts [minimum length 2.7559 in. (70 mm)] in their place. Gradually unscrew the four remaining bell housing bolts so as to allow the gradual extension of the differential lock release spring.

NOTE: *It is necessary to install two bolts with a minimum length of 2.7559 in. (70 mm) because the normal bell housing bolts are not long enough to allow the spring to extend to its full free length.*



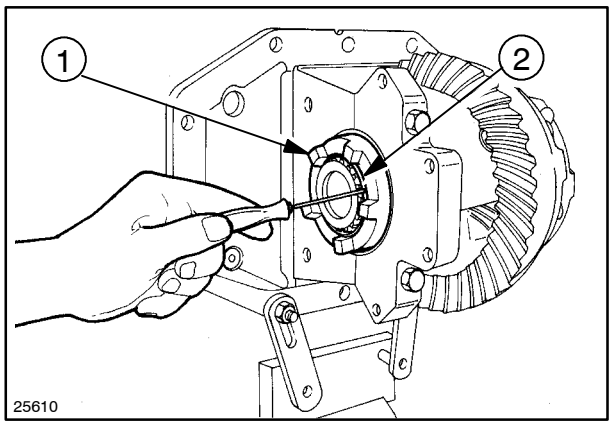
60

3. Unscrew the two 2.7559 in. (70 mm) bolts last of all, remove the bell (1), the spring (2) and differential lock control piston.



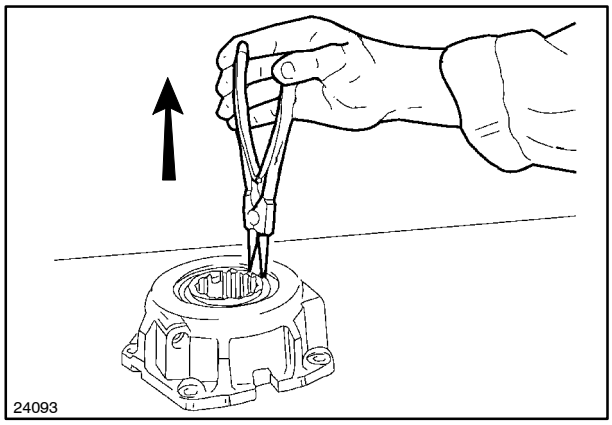
61

4. Using a screwdriver, remove the circlip (2) and the differential lock sleeve.



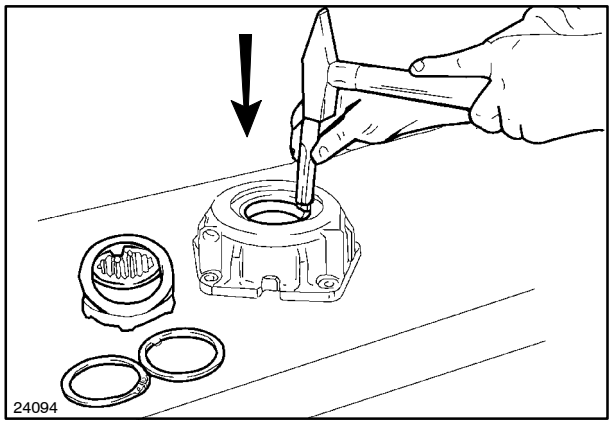
62

5. Remove the circlip securing the differential lock piston, recover the sliding sleeve with the two thrust washers.



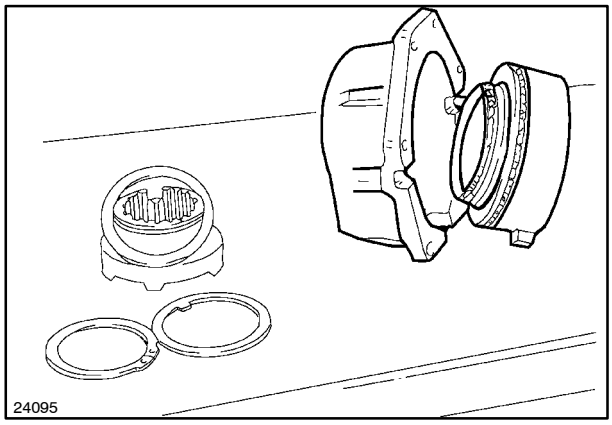
63

6. Gently **tap** the piston out of the clutch bell housing.



64

7. Remove the differential lock piston.
8. To refit the differential lock clutch parts follow the disassembly procedure in reverse order, proceeding as follows.
9. Carefully check the condition of the two O-ring seals installed on the piston.
10. Fit the clutch bell unit complete with spring and piston using the two 2.7559 in. (70 mm) bolts used during disassembly operations.



65

Op. 25 108 30
FRONT EPICYCLIC FINAL DRIVE WITHOUT BRAKE D.A.

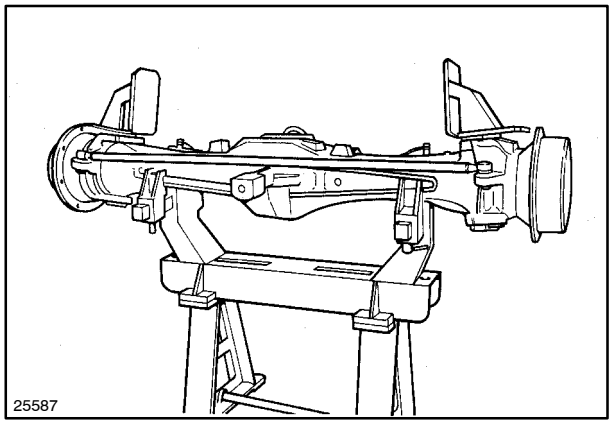
⚠ CAUTION ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Front epicyclic final drive removal and installation can be carried out with the axle detached and positioned on the stand **380000251**, or with the axle fitted on the tractor. If the operation is performed with the axle fitted on the tractor, a support stand must be positioned under the engine sump.

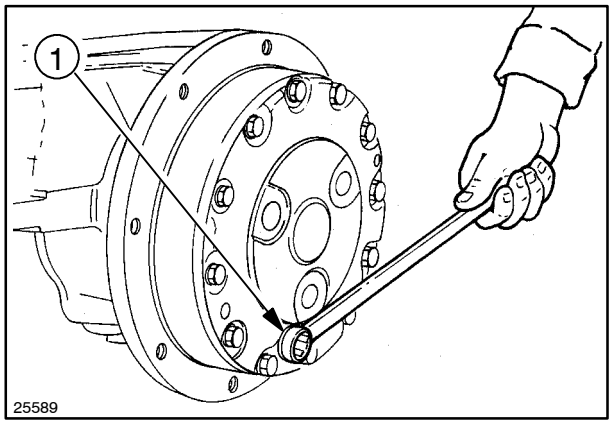
Proceed as follows.

1. Position the axle on stand **380000251**.



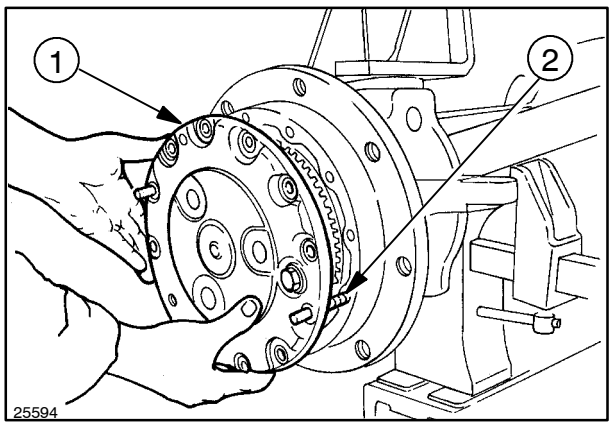
66

2. Remove the plug (1) and drain the oil from the epicyclic final drive.



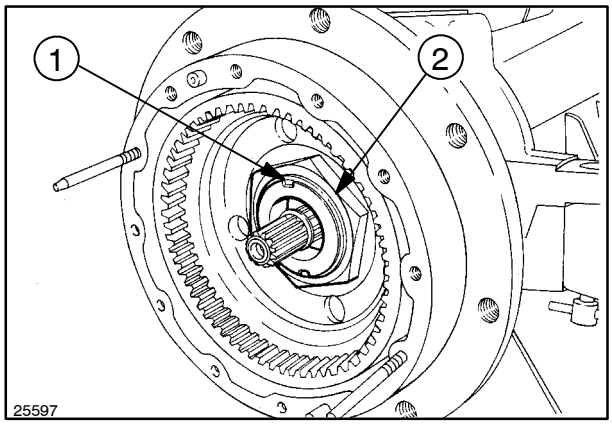
67

3. Take out the bolts retaining the cover (1) of the final drive, screw down two pins (2) and, using an extracting tool screwed into the hole in the oil drain plug, remove the cover (1).



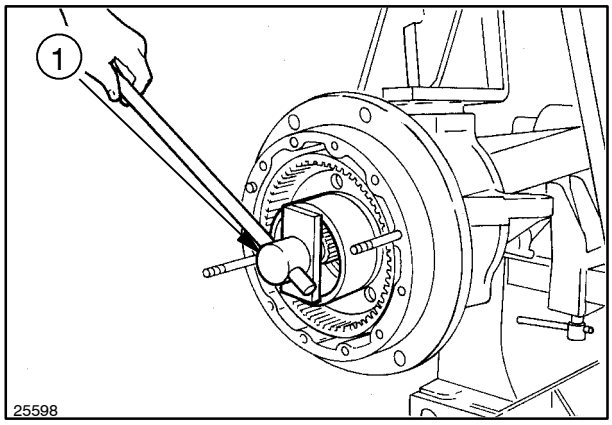
68

4. Remove the notching (1) on the ring nut (2) retaining the wheel hub bearings.



69

5. Remove the lock nut on the wheel hub bearings using wrench **380000295** (1).

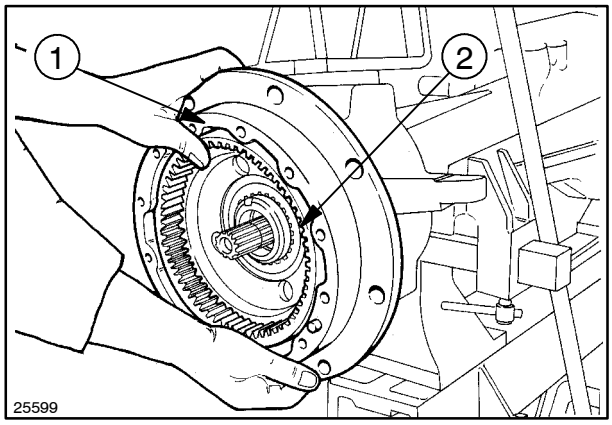


70

6. Remove the wheel hub (1) together with the epicyclic final drive fixed gear (2). Recover all disassembled parts.
7. To refit the front epicyclic final drive, proceed as follows.

⚠ CAUTION ⚠

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



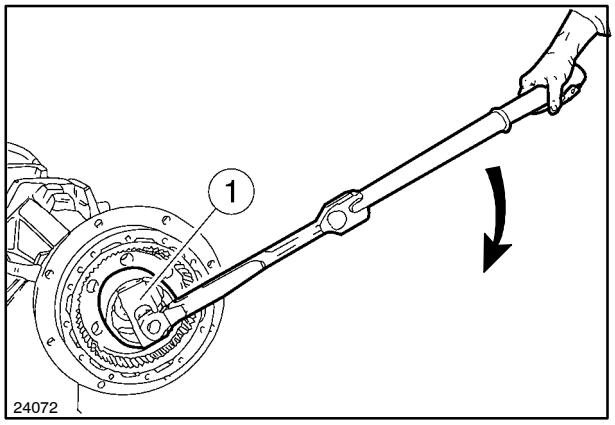
71

- For the correct orientation of the various parts, refer to the illustrations in figs. 6 and 7.

- Respect the tightening torque values indicated on page 4.

- Assemble the wheel hub and the epicyclic final drive fixed gear.

- Progressively tighten the ring nut, using the torque wrench and wrench **380000295** (1) to obtain a torque value of 392 Nm (40 kgm) at the same time, rotate the wheel hub to ensure that the bearings are correctly seated.
- Measure the rolling resistance (Rt) of the wheel hub using the relative torque wrench, or a torque meter and cord positioned on the base of the wheel disk flange.



72

- Loosen the ring nut by **half a turn** and measure the rolling resistance (R) as described previously. The difference between the two measurements is the rolling torque value of the wheel hub bearings (Rc):
- Rc = Rt - R = 5.9 to 14.7 Nm (0.6 to 1.5 kgm) or if measured with a torque meter.

  Rc = Rt - R = 16.53 to 41.33 lbs. (7.5 to 18.75 kg) **(models TL70 and TL80)**
- Rc = Rt - R = 10.58 to 26.45 lbs. (4.8 to 12 kg) **(models TL90 and TL100)**
- If the value is less than a 5.9 Nm (0.6 kgm) or, with the torque meter, 16.53 lbs (7.5 kg) **(for models TL70 and TL80)** or 10.58 lbs. (4.8 kg) **(for models TL90 and TL100)** replace the relevant parts and repeat the test.
- Progressively tighten the ring nut, using the torque wrench and wrench **380000295** (1) to obtain a torque value of 392 Nm (40 kgm); at the same time, rotate the wheel hub to ensure that the bearings are correctly seated.
- Carefully secure the ring nut.
- Before reassembling the epicyclic final drive casing, carefully clean and degrease the mating surfaces, then apply sealing compound [approx. 0.0787 in. (2 mm)] along the marked line shown in fig. 106.
- Assemble the epicyclic final drive casing, complete with gears.
- Fill up the front epicyclic final drive (for recommended products and quantities see Section 00).
- Fit the track rods.

WHEEL HUB SEAL
WITHOUT BRAKE Replacement

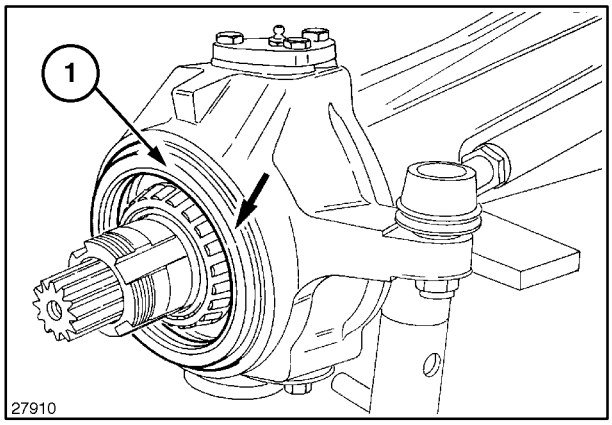
⚠ CAUTION ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Proceed as follows:

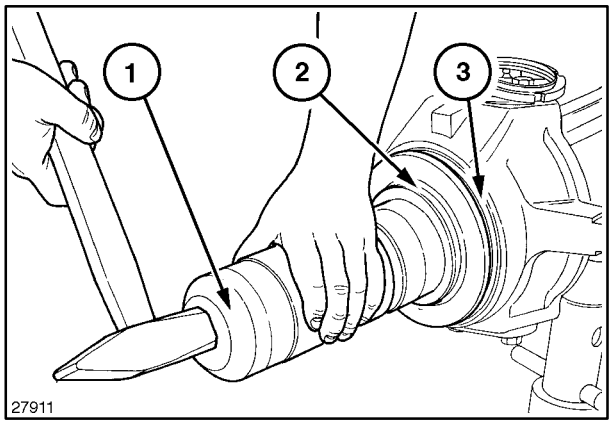
1. Disassemble the front epicyclic final drive without brake (see page 35).
2. Remove the hub casing (1) and the spacer.
3. Remove the worn seal, carefully clean the seat and position the new seal (1) on the seat fitting.

NOTE: *The external surface on the seal (1), indicated by the arrow, does not require lubrication.*



73

4. Fit tool **380000287** (2) on the hub and fit, by a few mm, the seal (3) using a striker (1) (only for models TL70 and TL80).

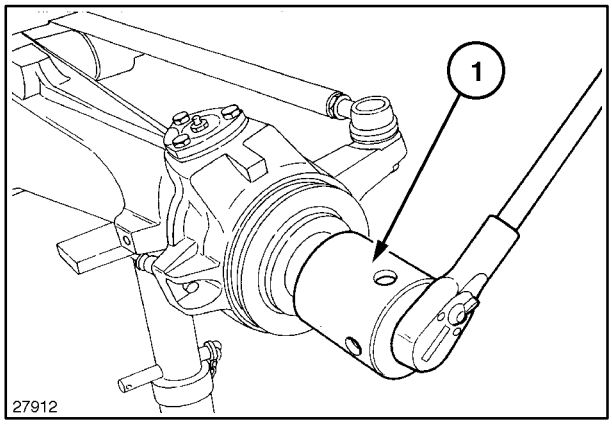


74

5. Fully fit the seal in position using the ring nut and wrench **380000295** (1).
6. To refit the wheel hub parts, proceed as follows.

⚠ CAUTION ⚠

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



75

- Remove tool **380000287** from the hub.
- Mount the front epicyclic final drive without brake (see page 36).

Op. 25 108 30
FRONT EPICYCLIC FINAL DRIVE WITH BRAKE D.A.

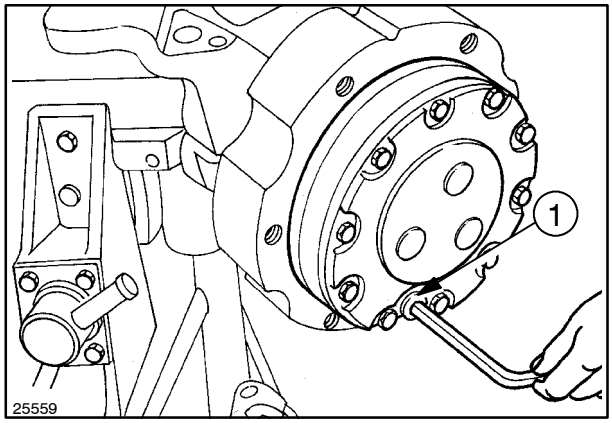
⚠ CAUTION ⚠

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Front epicyclic final drive removal and installation can be carried out with the axle detached and positioned on the stand **380000251**, or with the axle fitted on the tractor. If the operation is performed with the axle fitted on the tractor, a support stand must be positioned under the engine sump.

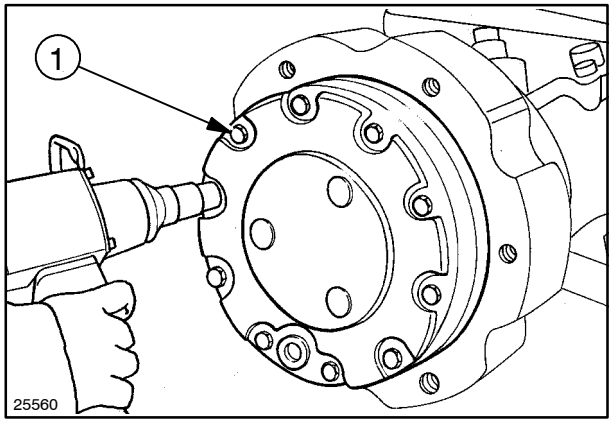
Proceed as follows

1. Position the axle on stand **380000251**.
2. Remove the plug (1) and drain the oil from the epicyclic final drive.



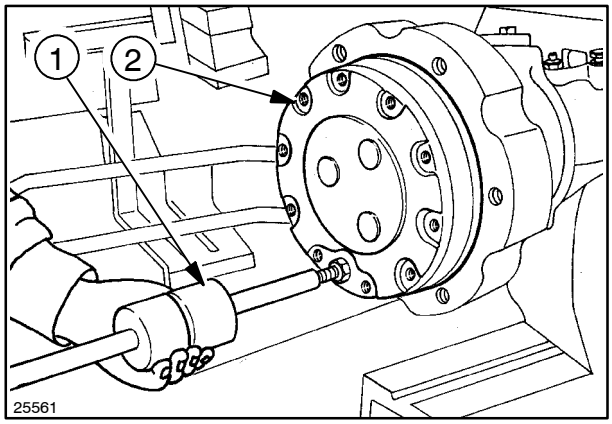
76

3. Unscrew all of the epicyclic final drive casing retaining bolts (1).



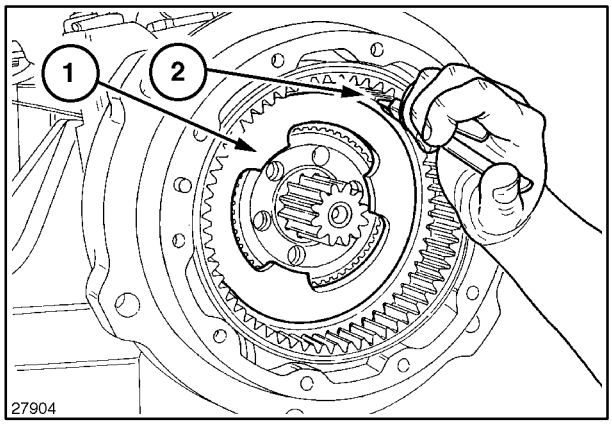
77

4. Using an extractor (1), fitted on the oil drainage plug, detach the epicyclic final drive casing (2).



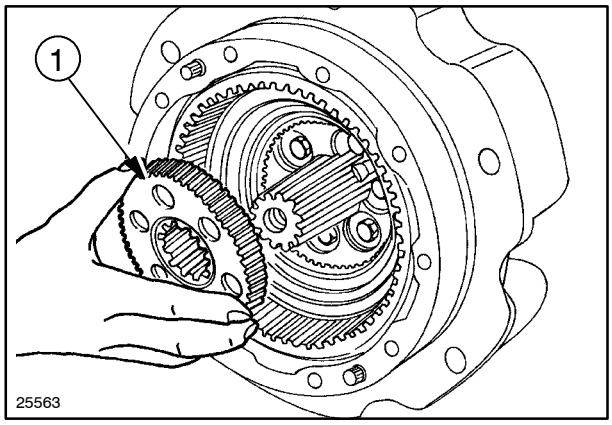
78

5. Remove the circlip (1) and extract the external brake disk (2).



79

6. Remove the hub (1) and associated brake friction disk.

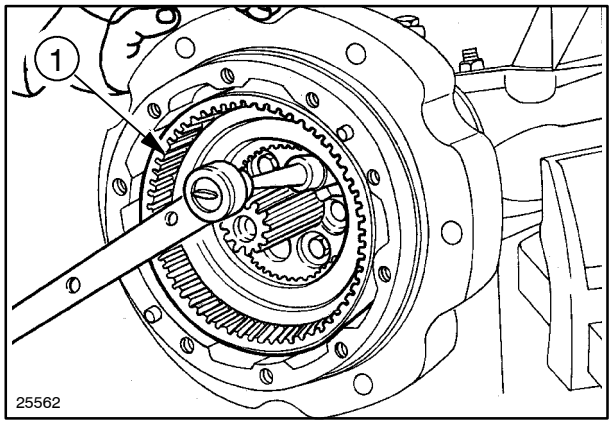


80

7. Take out the retaining bolts and remove the final drive fixed gear (1) using two screws as an extractor.
8. To refit the front epicyclic final drive, proceed as follows.

⚠ CAUTION ⚠

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



81

- Refer to the figures 5, 6, and 7 for the positioning of the various parts.
- Respect the tightening torque values indicated on page 4.
- Refit the drive fixed gear.
- Refit the brake disk hub.
- Fit the outer brake disk and secure in position.
- Before reassembling the epicyclic final drive casing, carefully clean and degrease the mating surfaces, then apply sealing compound [approx. 0.0787 in. (2 mm)] along the marked line shown in fig. 106.
- Assemble the epicyclic final drive casing, complete with gears.
- Fill up the front epicyclic final drive (for recommended products and quantities see Section 00.

WHEEL HUB SEAL WITH BRAKE

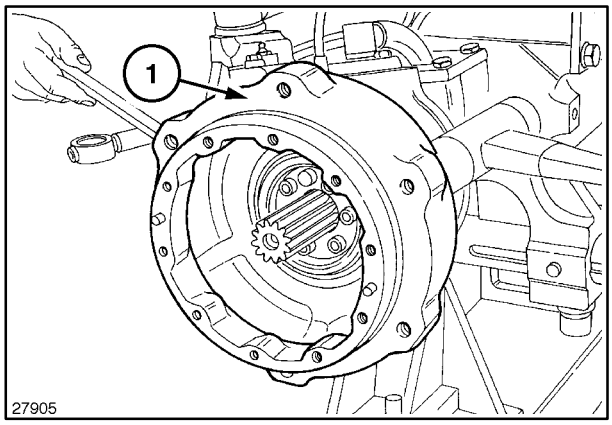
Replacement

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

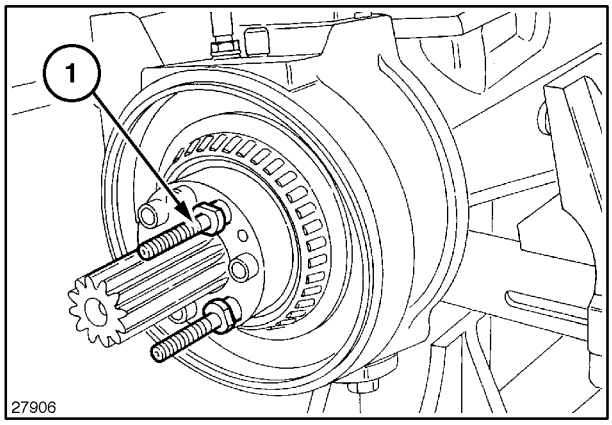
Proceed as follows

1. Disassemble the front epicyclic final drive with brake (see page 39) and remove the hub casing (1).



82

2. Remove the seal and fit the columns (1) of tool **380000286** (models TL70 and TL80) or **380000288** (models TL90 and TL100).

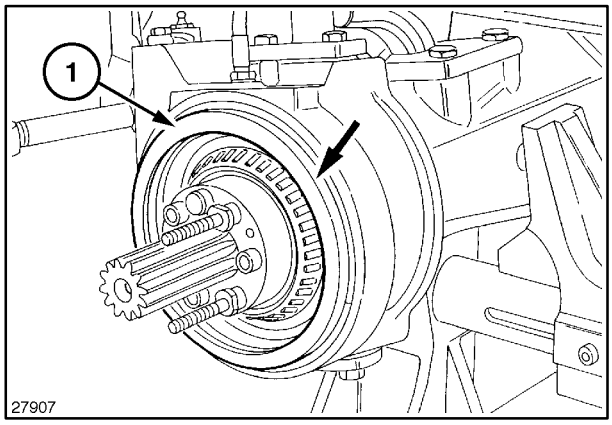


83

3. Carefully clean the seat and position the seal (1), ready for fitting.

NOTE: *The external surface on the seal (1), indicated by the arrow, does not require lubrication.*

4. Fit the seal (2, fig. 85) fully tightening the screws on tool **380000286** (1) (models TL70 and TL80) or **380000288** (models TL90 and TL100).



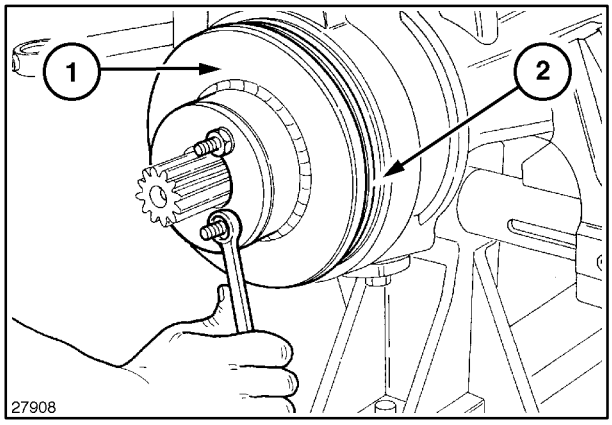
84

5. To refit the wheel hub parts, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Remove tool **380000286** (models TL70 and TL80) or **380000288** (models TL90 and TL100) from the hub.
- Mount the front epicyclic final drive with brake (see page 40).

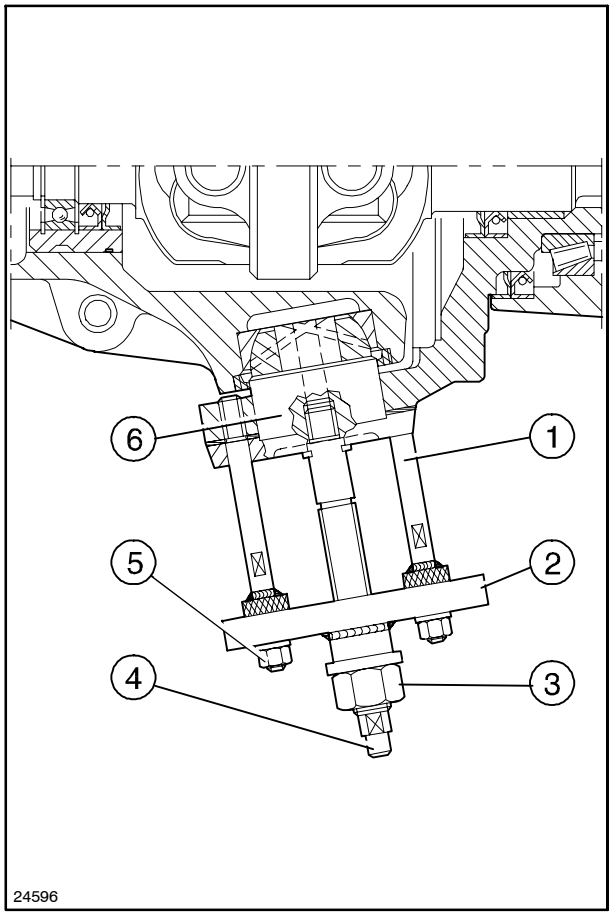


85

Op. 25 108 46
STEERING KNUCKLE PINS AND BEARINGS
Replacement

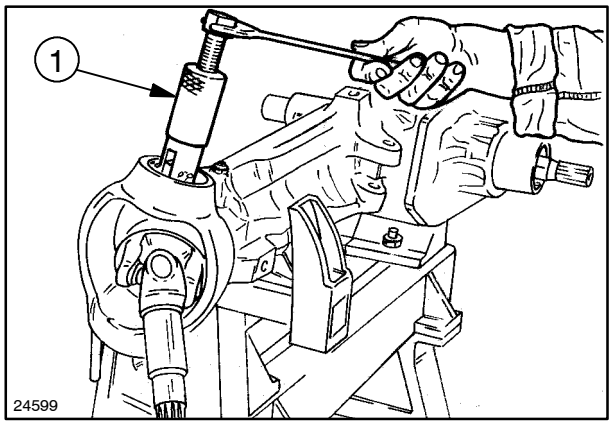
If steering knuckle pivot pins present problems during disassembly operations, proceed as follows.

1. Remove the grease nipples and the steering knuckle pin retaining bolts.
2. Fit the bolts (1) of tool **380000265**.
3. Fit the plate (2) of the tool and fix it to the three bolts with nuts (5).
4. Fit the tie-rod (4) screwing it fully into the grease nipple bore on the pin (6).
5. Screw in the nut (3) to drive the pin (6) out of its bore.



86

6. Using extractor **380000234** (1) remove the steering knuckle bearings.
7. Re-install the steering knuckle bearings using a suitable drift.



87

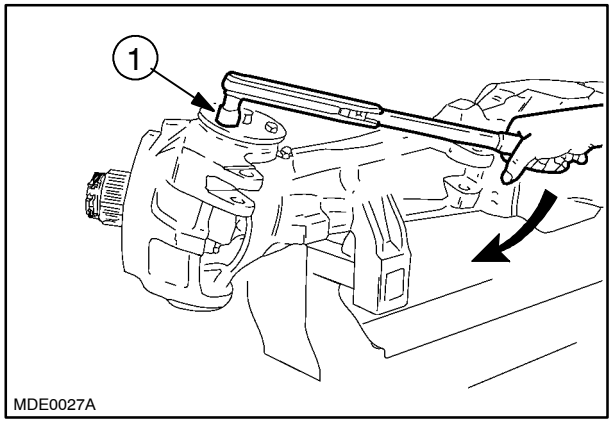
STUB AXLE ADJUSTMENTS

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

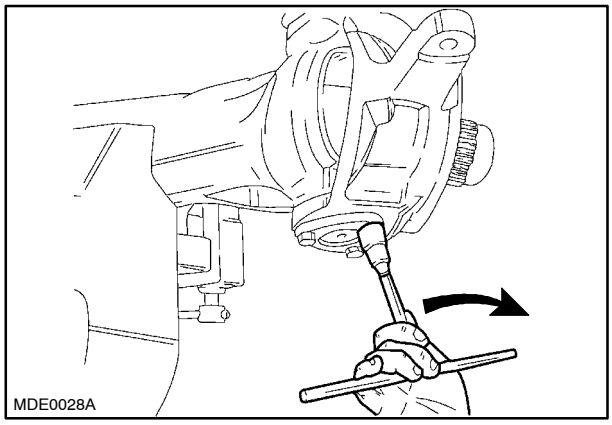
Position the front axle on stand **380000251** and proceed as follows:

1. Smear grease **AMBRA GR9 grease** on the outer races of the bearings and fit the upper cover, without the plates, but with tool **380000235** (2). Tighten the retaining bolts (C_5, fig. 1) to a torque of 64 Nm (6.5 kgm) for models TL70 and TL80 or to a torque of 113 Nm (11.5 kgm) for models TL90 and TL100.



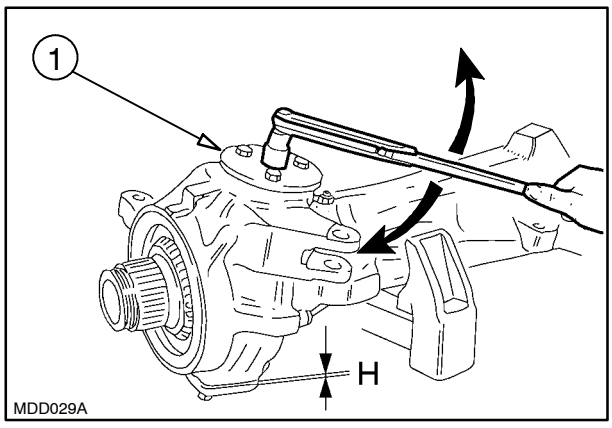
88

2. Fit the lower cover without adjustment plates, lubricate the three retaining bolts with engine oil.
3. Gradually tighten the lower cover bolts in sequence, while simultaneously rotating the casing to allow excess grease to escape.



89

4. Using a torque wrench and tool **380000235** (1), check that the torque required to rotate the casing is 2.9 Nm (0.3 kgm) (with a torque increase of 0.98 Nm - 0.1 kgm) for models TL70 and TL80, or 15 to 25 Nm (1.5 to 2.5 kgm) for models TL90 and TL100 without considering the peak starting value. If not, adjust by way of the lower cover bolts.
5. Measure the gap (H) created between the lower cover and the casing adjacent to each of the three bolts.



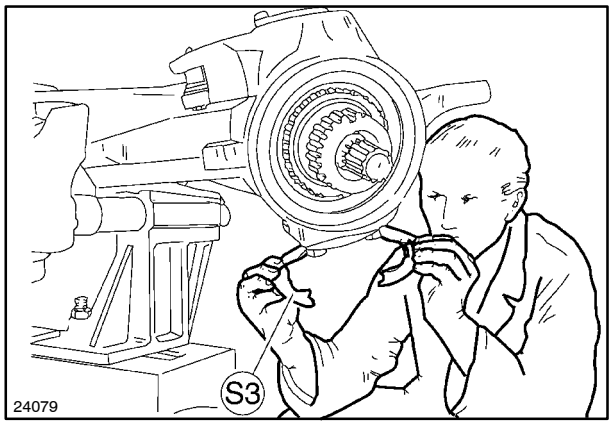
90

6. Calculate the average of the three values measured. The total thickness of the adjustment plates (10, figs. 6 and 7) to be fitted under the lower cover will be given by:

   S_3= H (models TL70 and TL80)

   S_3= H – 0.0078 in. (0.20 mm) (models TL90 and TL100).

   If necessary, round the value down to the next 0.0019 in. (0.05 mm).



91

7. Partially unscrew the lower cover bolts, insert the shims (10, figs. 6 and 7) and tighten the bolts (C_5, fig. 1) to a torque of 64 Nm (6.5 kgm) for models TL70 and TL80 or 113 Nm (11.5 kgm) for models TL90 and TL100.

8. Check that the torque necessary to rotate the casing is 2.9 to 7.8 Nm (0.3 to 0.8 kgm) for models TL70 and TL80, or 118 to 147 Nm (12 to 15 kgm) for models TL90 and TL100, without considering the initial peak torque.

9. If the torque value measured is greater than the prescribed value, increase the thickness of the shims; if the measured value is less than the prescribed value, reduce the thickness of the shims.

10. Assemble the grease fittings in the upper and lower covers and grease the assembly.

BEVEL DRIVE ADJUSTMENTS

Adjusting the bevel pinion shaft bearing preload with shims (12, figs. 6 and 7).

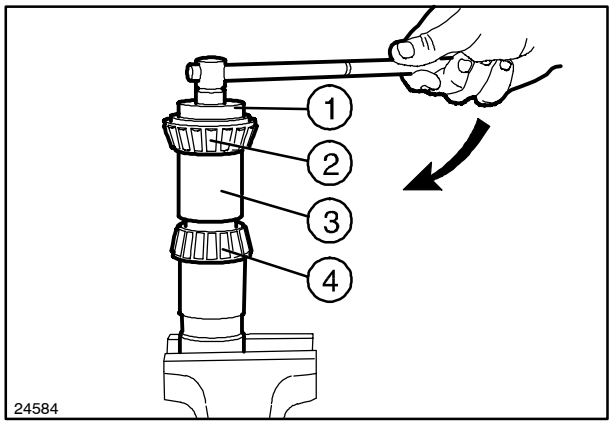
CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

Proceed as follows:

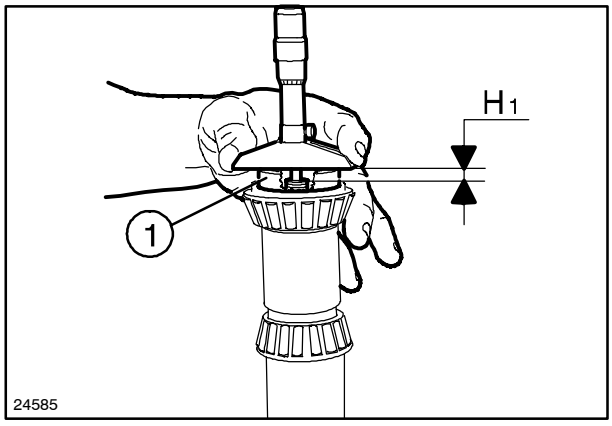
1. Clamp tool **380000248** (1) in the vice, install the inner rings on the bearings (2 and 4), the spacer (3) and fully tighten the nut on the tool.

NOTE: *For models TL70 and TL80 put the spacer (Ø48x10 part of tool **380000248**) between tool **380000248** (1) and the bearing (2).*



92

2. Using the micrometer, measure the distance (H_1) between the upper surface and the tip of the pin of tool **380000248** (1).
3. Disassemble the parts mentioned above, lubricate the bearings with engine oil and then reassemble the parts, except for the spacer (3, fig. 92), in the bevel drive-differential housing, complete with outer bearing races, held in the vice with tool **380000255**.
4. Fully tighten the nut on the tool **380000248** (1) (see **Note** above) whilst turning the tool to ensure that the bearings are seated correctly.



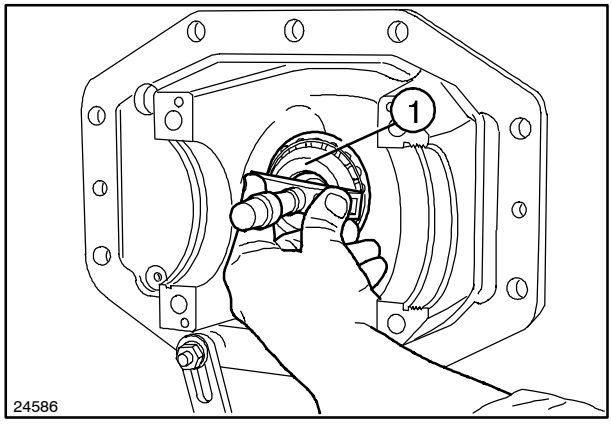
93

5. Using a micrometer, measure the distance (H_2) taken on by the tool in this condition.
6. The thickness of the adjustment shim (12, figs. 6 and 7) to fit is given by:

   $S = H_2 - H_1 + 0.0019$ in. (0.05 mm)

If necessary, round the adjustment shim (12) up tothe nearest 0.0019 in. (0.05 mm).

NOTE: *On completing the adjustment, do not remove the adjustment tool from the bevel drive-differential housing: leave in place for adjustment of the bevel pinion assembly position.*



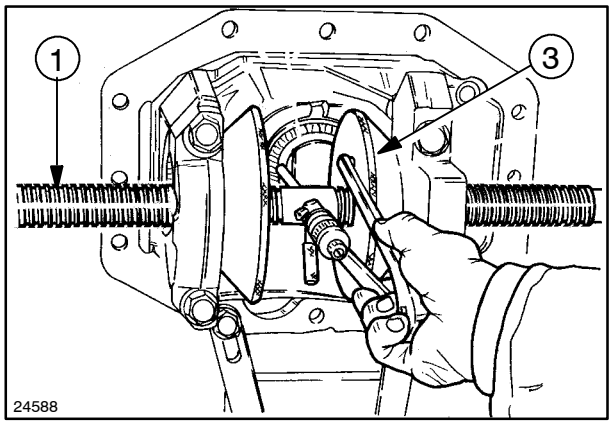
94

BEVEL DRIVE ADJUSTMENTS

Determining the thickness of the drive pinion position adjustment shim (11, figs. 6 and 7).

Proceed as follows:

7. Fit tool **380000249** (1) in the bevel drive-differential housing, complete with outer bearing rings, crown wheel bearing adjustment ring nut, crown wheel bearing adjustment shim, circlip and differential housing caps.



95

8. Screw the cones (3) of tool **380000249** (1) in or out in order to position the micrometer shaft in the direction of the inner bearing ring (2) and eliminate end float between the cones and the outer rings of the bevel crown wheel bearings.
9. Adjust the micrometer so that the shaft is in contact with the inner bearing ring (2) and measure the distance (H_3).
10. Determine the correct distance (H_5) between the crown wheel axis and the large diameter base of the pinion:

$$H_5 = H_4 \pm C$$

- where:
- **H_4** = 3.7401 in. (95 mm) for models TL70 and TL80 or 4.5275 in. (115 mm) for models TL90 and TL100. Nominal distance between the crown wheel axis and the large diameter base of the pinion (see figs. 6 and 7).
- **C** = correction value stamped on pinion, in mm and preceded by a + or - sign (if other than 0), to be added to or subtracted from the nominal distance (H_4) according to the sign.

11. The thickness of the adjustment shim (11, figs. 6 and 7) will be given by:

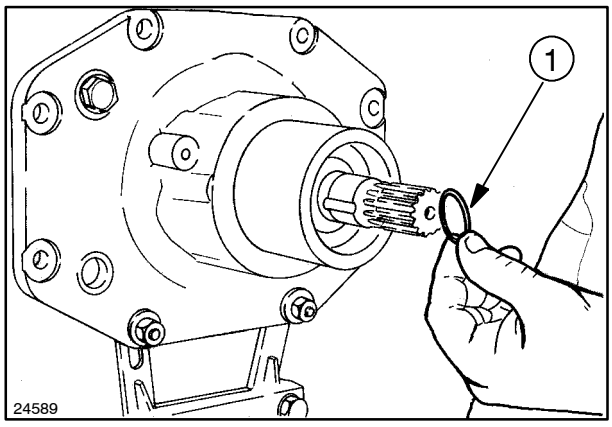
$$S = H_3 - H_5$$

- where:
- **H_3** = the distance measured using the micrometer;
- **H_5** = corrected nominal distance between the crown wheel axis and the large diameter base of the pinion.

Example (models TL90 and TL100).

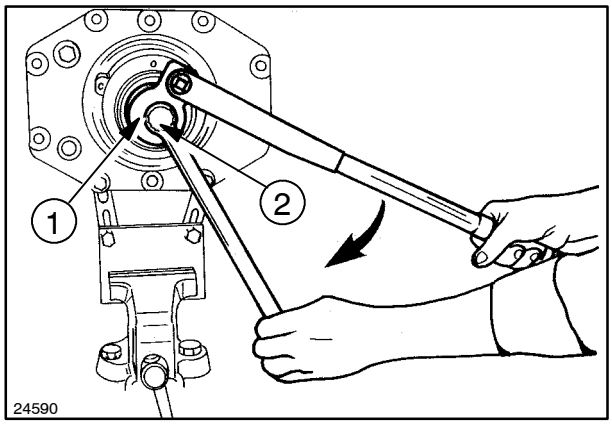
- Distance measured using micrometer H_5 = 4.6456 in. (118 mm).
- Nominal distance between crown wheel axis and large diameter base of pinion H_4 = 4.5275 in. (115 mm).
- Correction value C = + 0.0078 in. (0.2 mm).
- Corrected nominal distance H_5 = 4.5275 + 0.078 = 4.5354 in. (115 + 0.2 = 115.2 mm).
- Thickness of the adjustment shim S = 4.6456 + 4.6055 = 9.2511 in. (118 - 115.2 = 2.8 mm).
- Correction value C = - 0.0078 in. (0.2 mm).
- Corrected nominal distance H_5 = 4.5275 - 0.078 = 4.5196 in. (115 - 0.2 = 114.8 mm).
- Thickness of the adjustment shim S = 4.6456 - 4.5196 = 0.1259 in. (118 - 114.8 = 3.2 mm).
- Correction value C = 0 mm.
- Corrected nominal distance H_5 = H_4 = 4.5275 in. (115 mm).
- Thickness of the adjustment shim S = (4.6456 + 4.5275 = 0.1181 in.) 118 - 115 = 3 mm.

12. Remove tools **380000248** and **380000249** from the bevel drive housing.
13. Fit the drive pinion complete with: inner bearing rings, spacer and pre-determined adjustment shims (11 and 12).
14. Fit the O-ring (1) on the bevel pinion shaft.
15. Insert the spacer on the pinion and, after having carefully greased the outer surface, fit the anti-rotation ball.



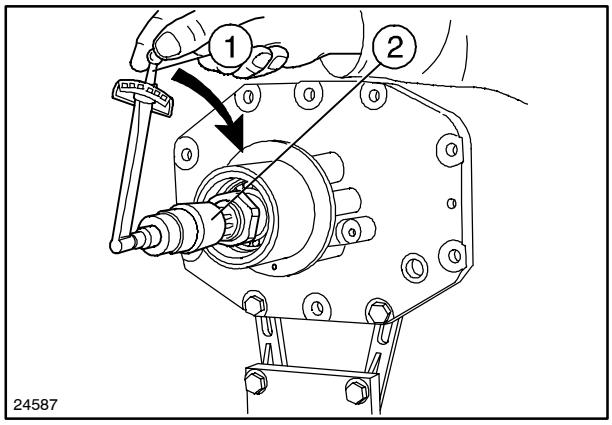
96

16. Fit pinion retaining tool **380000257** (2).
17. Insert wrench **380000268** on the adjuster ring nut.
18. Using the torque wrench on the pinion retaining wrench (2), hold the bevel pinion in position and, using a torque wrench (positioned as in the figure) on the ring nut wrench (1), tighten the ring nut (C_3, fig. 1) to a torque of 294 Nm (30 kgm), whilst rotating the pinion shaft to ensure perfect bearing fit.



97

19. With torque wrench (1) fitted on pinion retaining wrench **380000257** (2), check that the pinion rolling torque, without oil seal (13, figs. 6 and 7) and relative dust seal, is 0.5 to 1 Nm (0.050 to 0.100 kgm).
    If the rolling torque is less than the prescribed value, fit a thinner adjustment shim (12, figs. 6 and 7); if the torque is greater than the prescribed value, fit a thicker adjustment shim.



98

20. Remove the ring nut and install the seal (13, figs. 6 and 7) and the dust seal. Tighten the nut to a torque value of 294 Nm (30 kgm) while simultaneously rotating the pinion shaft to ensure that the bearings are seated correctly.

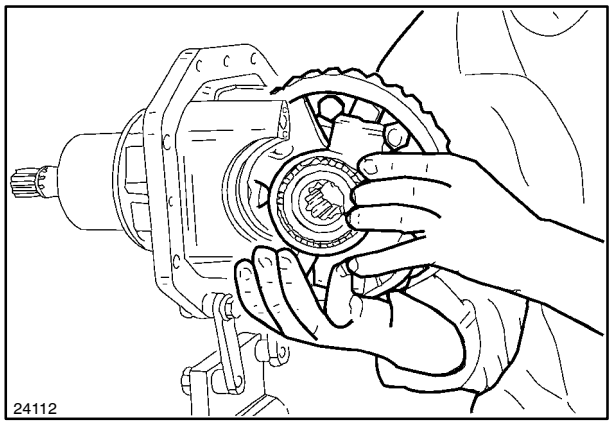
21. With torque wrench (1) fitted on pinion retaining wrench **380000257** (2) check that the pinion rolling torque, with the oil seal and relative dust seal, is ≤ 0.50 Nm (0.050 kgm) for models TL70 and TL80) or ≤ 0.75 Nm (0.075 kgm) for models TL90 and TL100.
    Finally, secure the ring nut and fit the circlip on the bevel pinion shaft.

BEVEL DRIVE ADJUSTMENTS

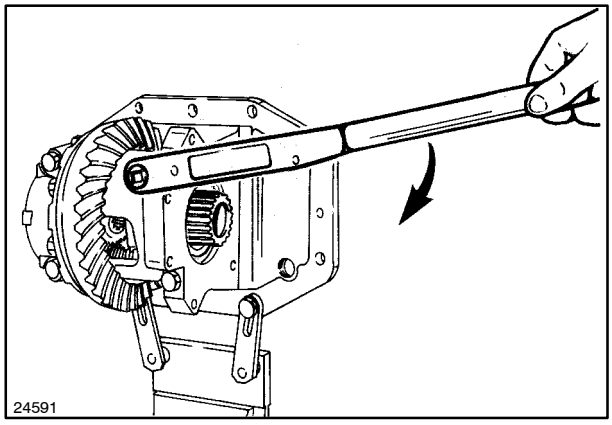
Adjusting the bevel crown wheel bearings and checking the clearance between the sides of the bevel drive teeth.

Proceed as follows:

22. Install the differential assembly complete with crown wheel and inner bearing rings on the differential bevel drive support.
23. Insert the outer rings on the bevel drive-differential support, install the differential casing support caps, tighten the relative bolts to a torque value of 59 Nm (6 kgm), then loosen and re-tighten to a torque of 20 Nm (2 kgm).
24. Fit the adjuster shim (4, figs. 6 and 7) that was previously removed during the axle overhaul operation, and the relative circlip.

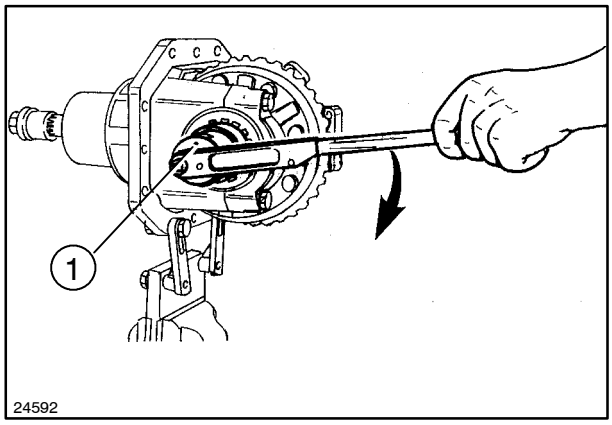


99



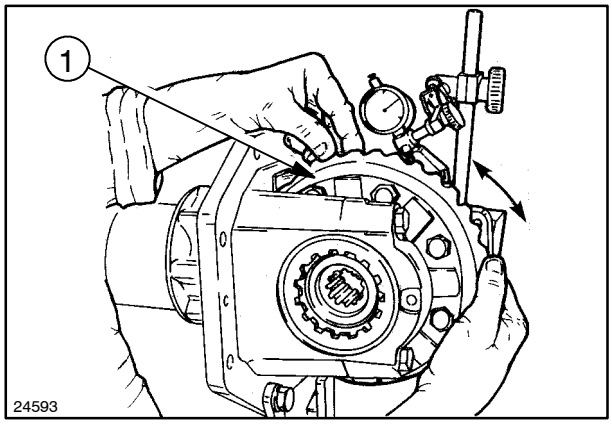
100

25. With the bearings perfectly lubricated, rotate the bevel crown wheel and, at the same time, tighten the ring nut using wrench **380000252** (1) for models TL70 and TL80 or with wrench **380000253** (1) for models TL90 and TL100 to reach a torque of 39 to 59 Nm (4 to 6 kgm) to ensure axial recovery of the clearance between parts.
26. Measure the backlash between the bevel crown wheel tooth flanks, using a 1/100 dial gauge perpendicular to the outer edge of a tooth on the crown wheel (1, fig. 102).



101

27. Repeat the measurement in a further two positions 120° and compare the average of the three values (Gm) with the prescribed normal backlash: 0.0070 to 0.0090 in. (0.18 to 0,23 mm) **average 0.0078 in. (0.20 mm)** (models TL70 and TL80) or 0.0059 to 0.0078 in. (0.15 to 0.20 mm), **average 0.0070 in. (0.18 mm)** (models TL90 and TL100).
    If the measured backlash exceeds the prescribed value, fit a thinner adjustment shim (4, figs. 6 and 7).



102

NOTE: On standard models (fitting without differential lock) if the clearance value is not within the prescribed field of tolerance, unscrew one of the ring nuts, whilst tightening the other to an equal amount, so as to reset the prescribed clearance.

The definitive value (4, figs. 6 and 7) to fit on the bevel drive-differential support will be given by:

- **S = Sp - {(Gm - 0.20) x 1.35}**
  (for models TL70 and TL80)

or:

- **S = Sp - {(Gm - 0.18) x 1.35}**
  (for models TL90 and TL100)

where:

Sp = thickness of test shim installed in the bevel drive-differential housing;

Gm = average backlash measured between the sides of the teeth of the bevel drive.

If the backlash measured is less than the prescribed value, it will be necessary to fit a thicker adjustment shim (4, figs. 6 and 7) the value being given by:

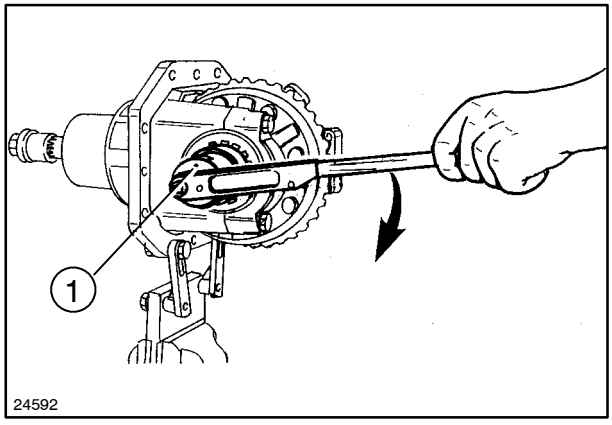
- **S = Sp + {(0.20 - Gm) x 1.35}**
  (for models TL70 and TL80) or
- **S = Sp + {(0.18 - Gm) x 1.35}**
  (for models TL90 and TL100)

28. Fit shim (4, figs. 6 and 7) of the calculated thickness and with a 1/100 scale dial gauge positioned perpendicular to the outside edge of one of the crown wheel teeth, check that the backlash between the bevel crown wheel tooth flanks is within the prescribed tolerance limits 0.0070 to 0.0090 in. (0.18 to 0.23 mm) (models TL70 and TL80) or 0.0059 to 0.0078 in. (0.15 to 0.20 mm) (models TL90 and TL100).
29. Using wrench **380000252** (1) for models TL70 and TL80 or with wrench **380000253** (1) for models TL90 and TL100, adjust the ring nut and check, using torque wrench (1), that the rolling resistance torque of the crown wheel and pinion bearings, as measured in the same conditions used to check only the pinion, is:

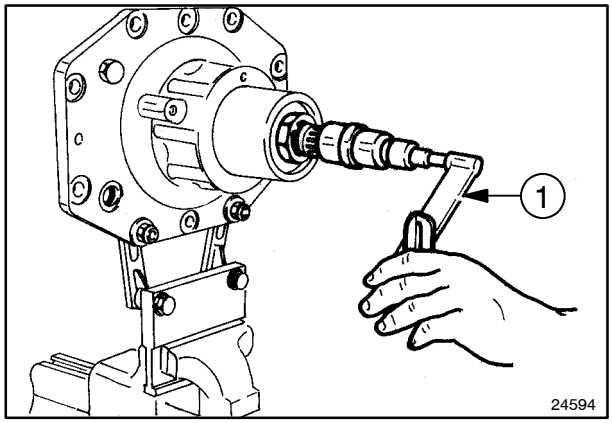
- **$A_2 = A_1 + 1$ to 1.5 Nm (0.10 to 0.15 kgm)**

where:

- **A_2** = pinion-crown wheel rolling resistance torque.
- **A_1** = rolling resistance torque of pinion only as previously measured.



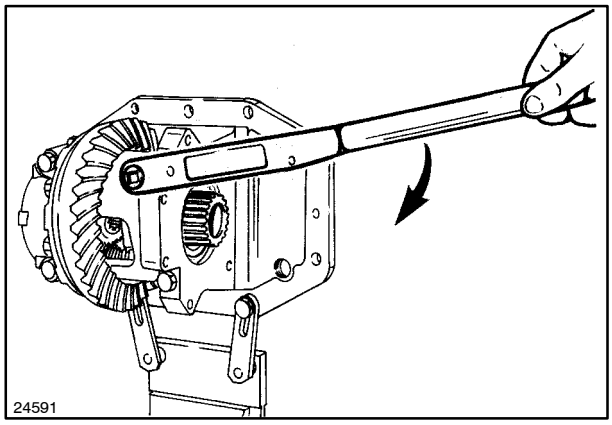
103



104

- **0.1 to 1.5 Nm (0.10 to 0.15 kgm)** = rolling resistance torque of crown wheel only measured at the end of the pinion, using an adapter and torque wrench.

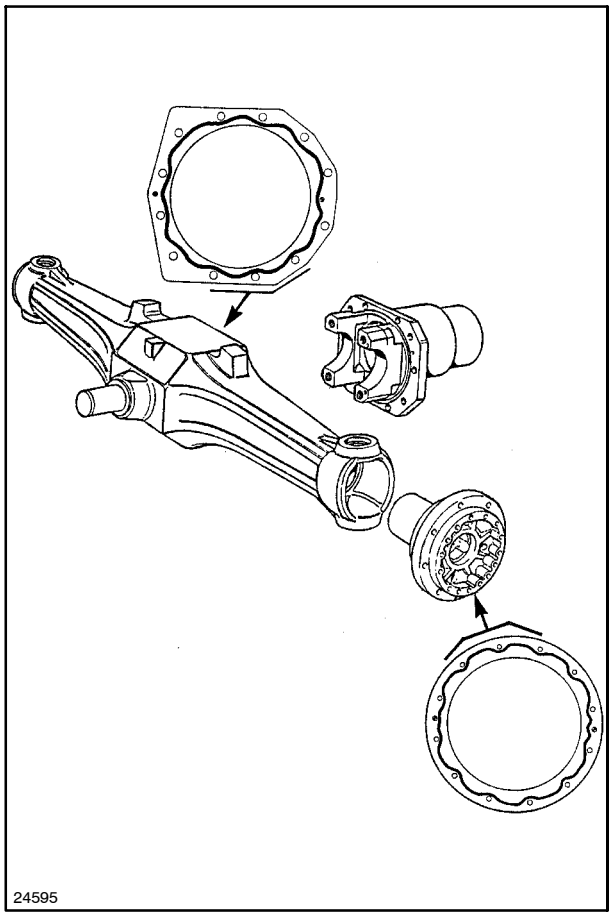
30. Tighten the cap retaining bolts (C_{10}, fig. 1) to a torque of 113 Nm (11.5 kgm).
31. Fit the safety plate, screwing the adjustment ring nut in or out, to reach the nearest notch.
32. Attach the bevel drive-differential to the axle casing after having carefully cleaned and degreased the mating surfaces and apply sealing compound [approx. 0.0787 in. (2 mm)] along the marked line shown in the drawing below.



105

Sealing compound application diagram for assembly of bevel drive unit and epicyclic final drive unit.

The types of sealing compounds to be applied are specified in Section 00.



106

SECTION 27 - REAR AXLE MECHANICAL TRANSMISSION

Chapter 1 - Rear axle mechanical transmission

CONTENTS

Operation	Description	Page
	Data	2
	Tightening Torques	3
	Tools	5
	Cross-sectional views	10
	Description and Operation	15
	Fault diagnosis	16
21 118 12	Gearbox-transmission casing R.I.	18
21 118 85	Gearbox/transmission casing D.A. and adjustments	39
27 110 10	Adjustments - differential lock control pedal travel	58
27 120 10	Final drive casing R.I.	59
27 120 32	Epicyclic final drive D.A.	62
27 120 34	Drive wheel shaft D.A.	63
	Platform R.I.	(See operation **90 110 36**)

BEVEL DRIVE AND DIFFERENTIAL DATA

		TL70	TL80 TL90 TL100
Bevel drive gear ratio:			
- 30 km/h version		9/43 = 1:4.8	
- 40 km/h version		11/43=1:3.91	
Clearance between sides of bevel drive gear teeth	in. (mm)	0.0070 to 0.0090 (0.18 to 0.23)	
Type of differential		with two planet gears	
Mechanically controlled differential lock		by means of pedal	
Differential release control for mechanical command		hydraulic, pedal-controlled, service brakes	
Electrohydraulically controlled differential lock		controlled by switch located on control panel	
Planet pinion internal seat diameter (5, figs. 12, 13 and 14)	in. (mm)	0.9464 to 0.9472 (24.040 to 24.061)	0.9858 to 0.9866 (25.040 to 25.061)
Planet pinion pin diameter (19, fig. 12 and 20, figs. 13 and 14)	in. (mm)	0.9424 to 0.9433 (23.939 to 23.960)	0.9818 to 0.9826 (24.939 to 24.960)
Clearance between planet pinions and pin	in. (mm)	0.0031 to 0.0048 (0.080 to 0.122)	0.0031 to 0.0048 (0.080 to 0.122)
Diameter of sun pinion hub seats on differential housing (3, figs. 12, 13 and 14)	in. (mm)	1.7354 to 1.7369 (44.080 to 44.119)	2.0118 to 2.0136 (51.100 to 51.146)
Sun gear hub diameter (17, fig. 12 and 18, figs. 13 and 14)	in. (mm)	1.7307 to 1.7322 (43.961 to 44.000)	2.0060 to 2.0078 (50.954 to 51.000)
Clearance between sun pinion hubs and seats	in. (mm)	0.0031 to 0.0062 (0.080 to 0.158)	0.0039 to 0.0075 (0.100 to 0.192)
Bevel pinion position adjustment		see page 49	
Bevel pinion position adjustment shims (8, fig. 10)	in. (mm)	0.0728 - 0.0748 - 0.0767 - 0.0787 - 0.0807 - 0.0826 - 0.0846 - 0.0866 - 0.0885 - 0.0905 - 0.0925 - 0.0944 - 0.0964 - 0.0984 - 0.1003 - 0.1023 - 0.1043 - 0.1062 (1.85 - 1.90 - 1.95 - 2.00 - 2.05 - 2.10 - 2.15 - 2.20 - 2.25 - 2.30 - 2.35 - 2.40 - 2.45 - 2.50 - 2.55 - 2.60 - 2.65 - 2.70)	
Bevel pinion support bearings adjustment		see page 51	
Bevel gear bearings adjustment and bevel drive coupling clearance		see page 52	
Clearance between sides of sun and planet pinion teeth	in. (mm)	0.0059 (0.15)	0.0070 (0.18)
Thickness of differential sun gear adjustment rings (16, fig. 12 and 17, figs. 13 and 14)	in. (mm)	0.0551 - 0.0590 - 0.0629 - 0.0669 - 0.0708 - 0.0748 - 0.0787 (1.4 - 1.5 - 1.6 - 1.7 - 1.8 - 1.9 (*) - 2.0) (*)	
Thickness of differential planet gear thrust washers (4, figs. 12, 13 and 14)	in. (mm)	0.0578 to 0.0602 (1.470 to 1.530)	
Adjustment of clearance between the sun and planet pinion teeth		see page 56	
Adjustment of differential lock		see page 48	
Thickness of differential lock control fork adjuster	in. (mm)	0.0196 (0.5)	
Differential lock control fork spring (Mechanical control):			
- spring free length	in. (mm)	8.6614 (220)	
- spring length under load of 177 to 195 N (1.81 to 19.9 kg)	in. (mm)	6.2007 (157.5)	
Differential lock control fork spring (Electrohydraulic control):			
- spring free length	in. (mm)	9.3307 (237)	
- spring length under load of 304 to 335 N (31.0 to 34.2 kg)	in. (mm)	6.2795 (159.5)	

(*) Only for models TL70.

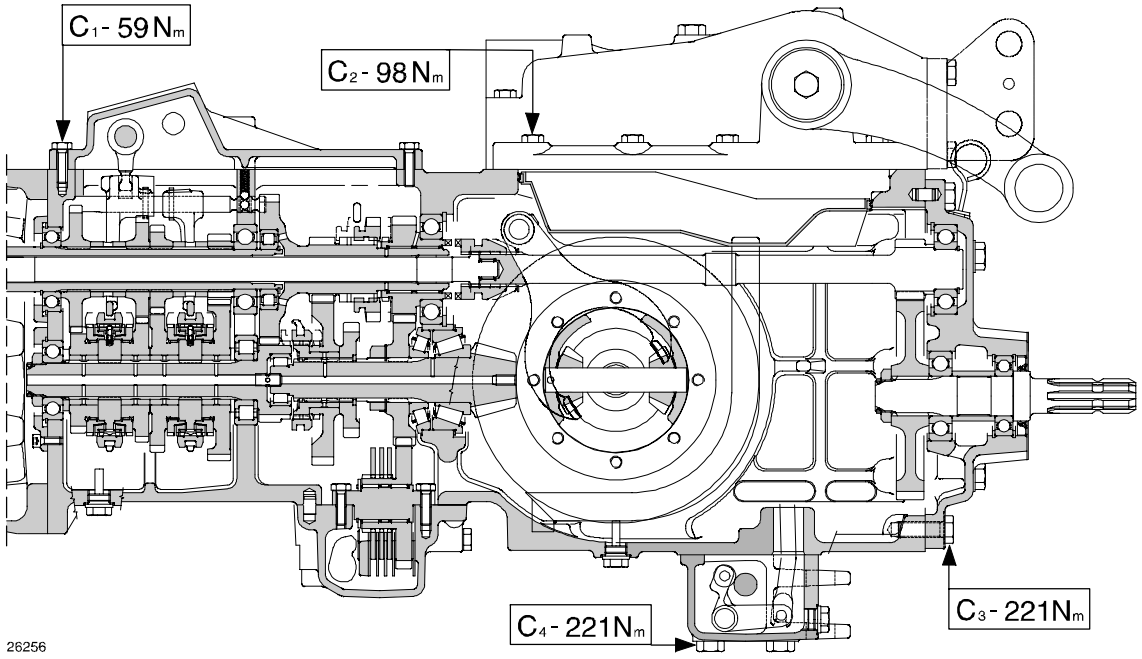
FINAL DRIVE DATA

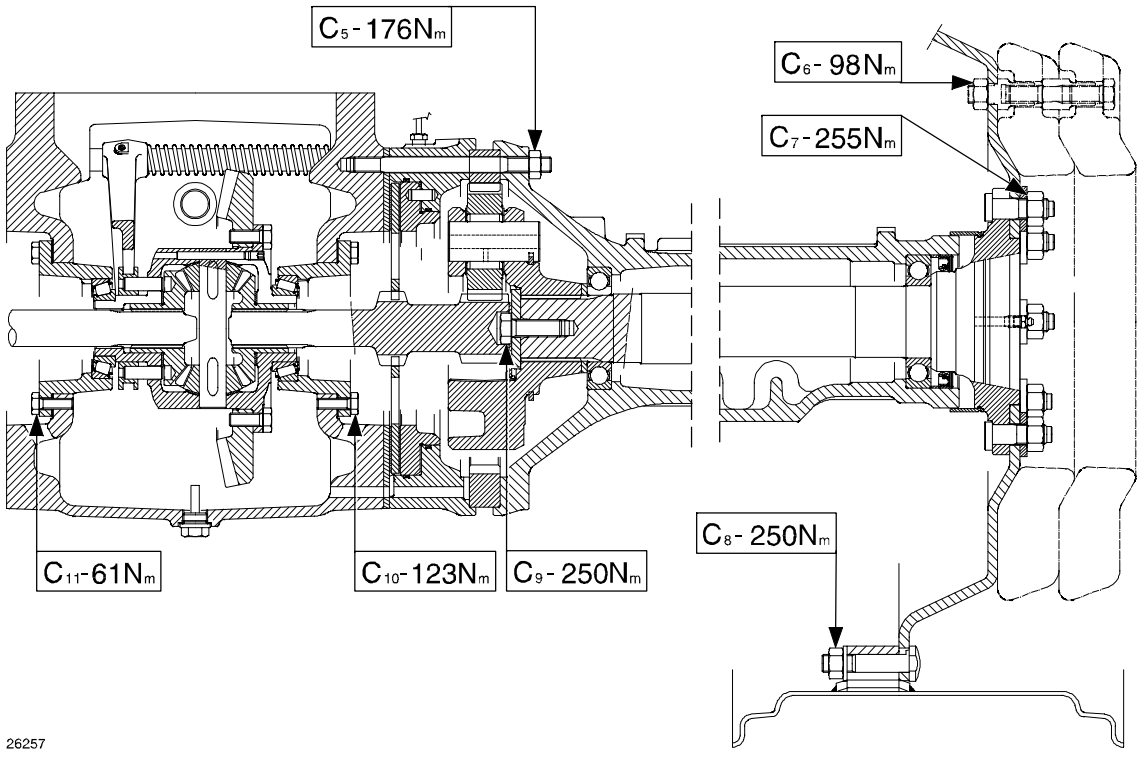
		TL70	TL80 TL90 TL100
Type		epicyclic with three planet gears with straight toothing	
Gear ratio		14:(14+64)= 1:5.57	13:(13+65)= 1:6
Thickness of planet gear adjustment rings (8, figs. 12, 13 and 14)	in. (mm)	0.0015 (0.0393) (1)	
Adjusting end float of planet gear casing		see page 64	
Thickness of planet gear casing end float adjustment rings (10, figs. 12, 13 and 14)	in. (mm)	0.1771 - 0.1811 - 0.1850 - 0.1889 - 0.1929 - 0.1968 - 0.2007 - 0.2047 - 0.2086 - 0.2125 - 0.2165 - 0.2204 - 0.2244 - 0.2283 (4.5 - 4.6 - 4.7 - 4.8 - 4.9 - 5.0 - 5.1 - 5.2 - 5.3 - 5.4 - 5.5 - 5.6 - 5.7 - 5.8)	

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Gearbox-transmission casing upper cover retaining bolts (C_1, fig. 1)	M 10 x 1.25	59	6
Bolts securing lift to rear transmission casing (C_2)	M 12 x 1.25	98	10
Retaining bolts securing power take-off casing to gearbox-transmission casing (C_3)	M 16 x 1.5	221	22.5
Bolts securing flex bar to the gearbox-transmission casing (C_4)	M 16 x 1.5	221	22.5
Nuts for stud bolts securing final drive casing to gearbox-transmission casing (C_5)	M 14 x 1.5	176	18
Nuts for drive wheel ballast ring retaining bolts (C_6)	M 14 x 1.5	98	10
Locknuts for drive wheel hub plate disk (C_7)	M 18 x 1.5	255	26
Nuts for bolts securing steel plate disc to drive wheel rim (C_8)	M 16 x 1.5	245	25
Drive wheel axle retaining bolt (C_9)	M 16 x 1.5	250	25.5
Bevel drive retaining bolts (C_{10})	M 12 x 1.25	123	12.5
Bevel drive support retaining bolts (C_{11})	M 10 x 1.25	61	6.2
Retaining bolts securing clutch casing to gearbox-transmission casing	M 12 x 1.25	98	10
Retaining bolts securing drive casing to gearbox-transmission casing	M 12 x 1.25	98	10
Nuts for drive wheel rim - RAIL disk retaining bolts	M 20 x 1.5	245	25
Nuts for drive wheel hub - fixed disk retaining bolts	M 18 x 1.5	314	32

TIGHTENING TORQUES





1

TOOLS

WARNING

The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

380000236 Tractor disassembly trolley.

380000227 Clutch casing lift hook.

380000301 Rotating stand for overhaul operations.

380000271 Front bracket (with **380000301**).

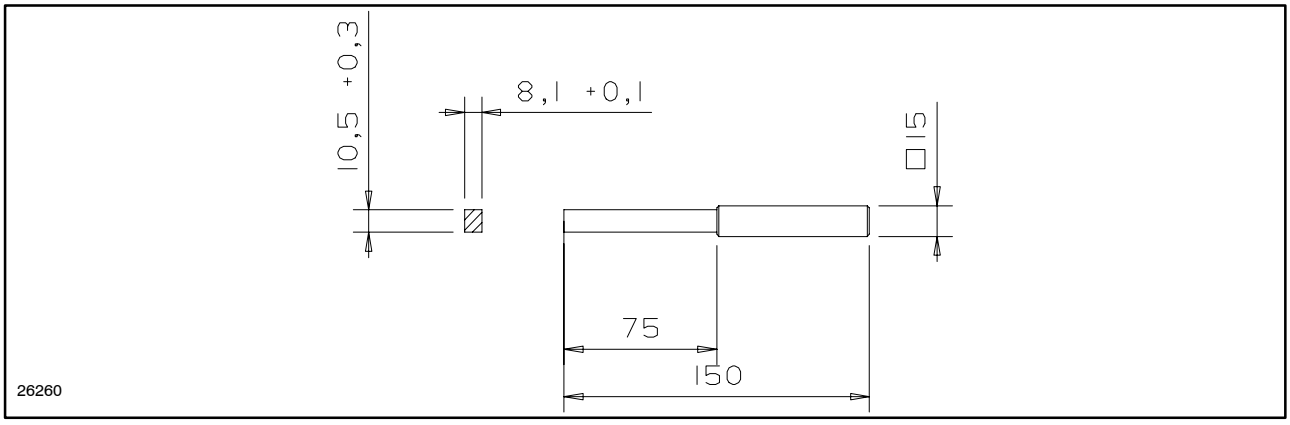
380000272 Rear bracket (with **380000301**).

380000249 Bevel pinion positioning gauge.

380000250 Tool for differential lock spring.

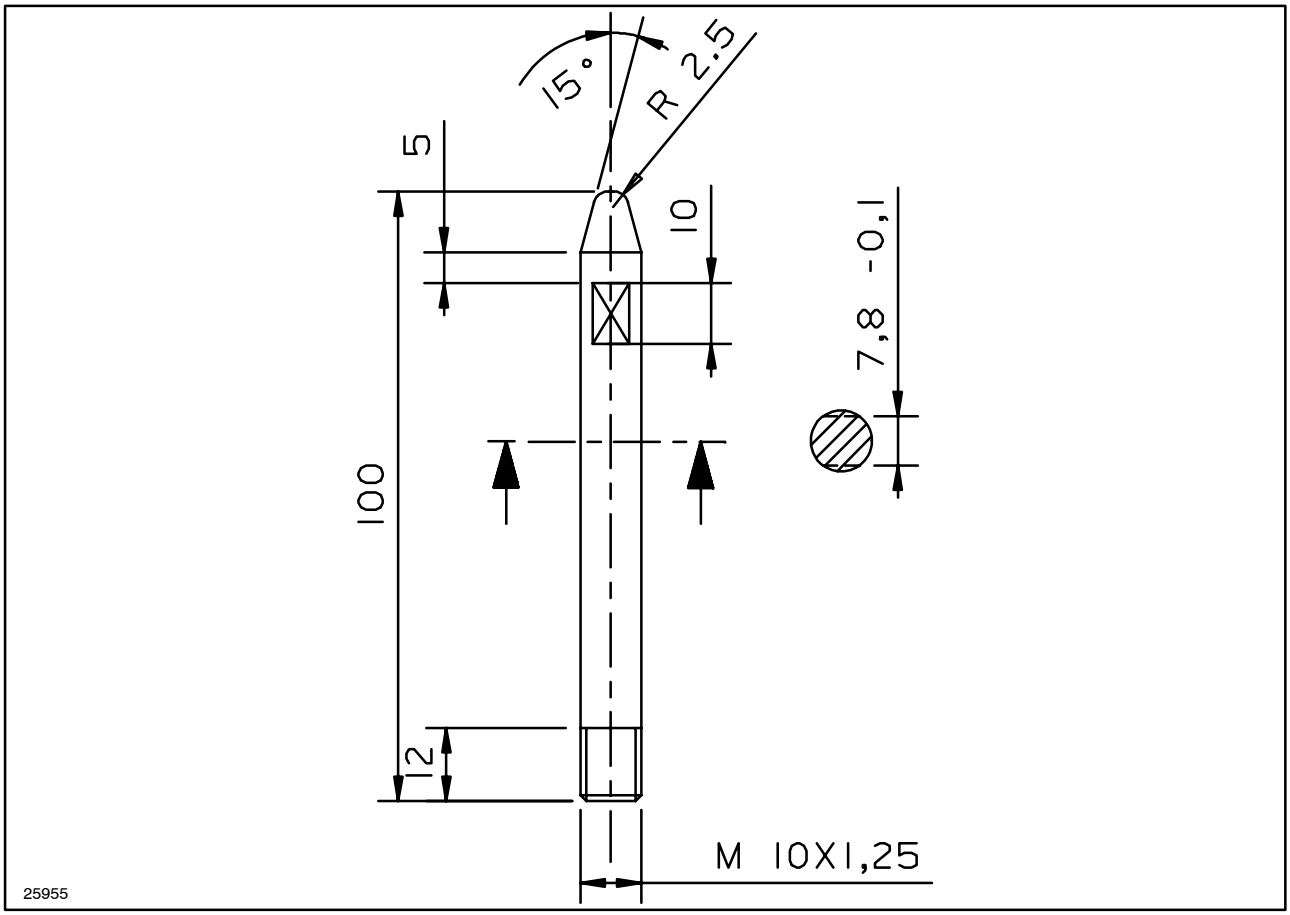
380000294 Cab lift adapter.

380000240 Universal hydraulic pressure control kit.



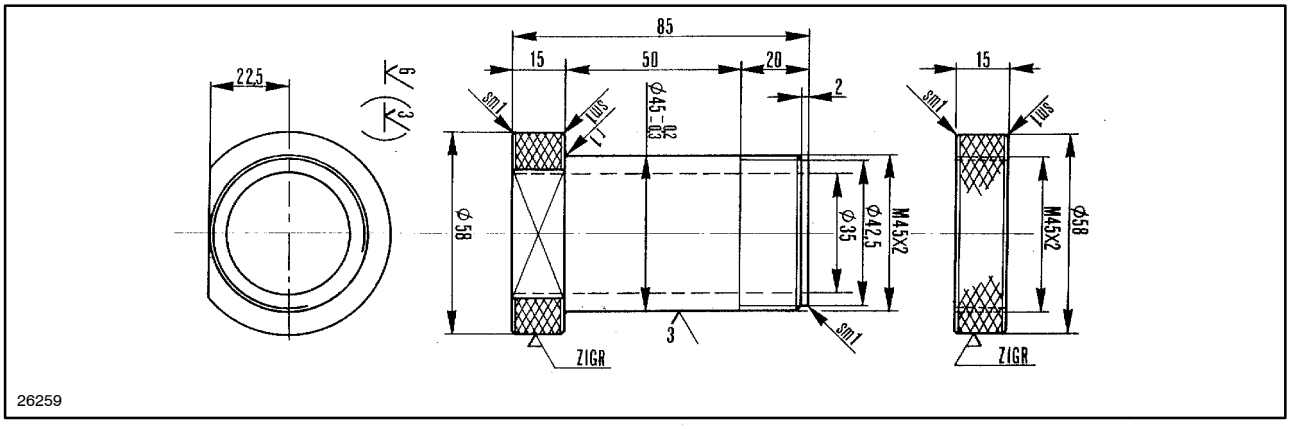
2

Tool to be constructed for adjusting differential lock sleeve travel
(Mark part with No. 50041 - Measurements in mm)
Make using C40 material.



3

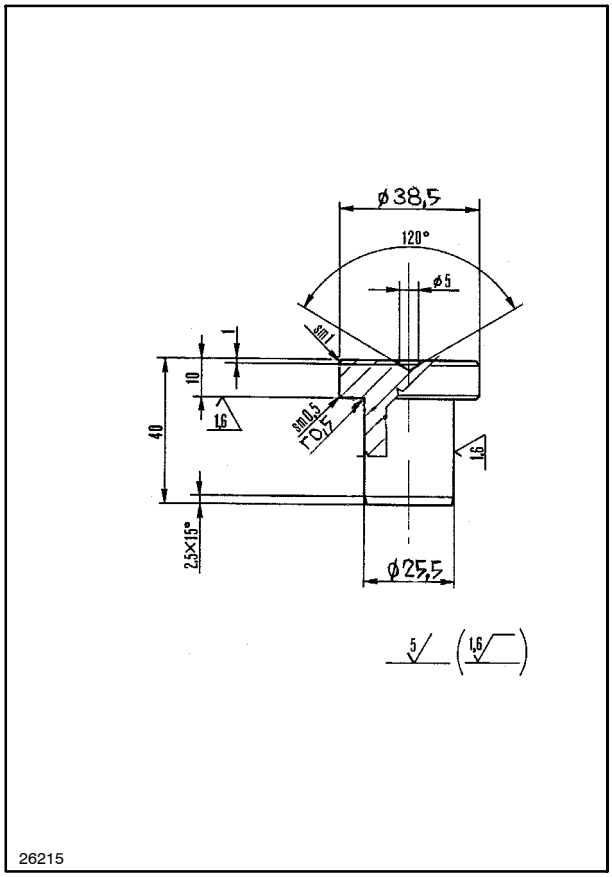
Tool to make for removal-installation of the final drive cover
(mark tool with no. 50164 - Measurements in mm)
Make in UNI C40 material.



4

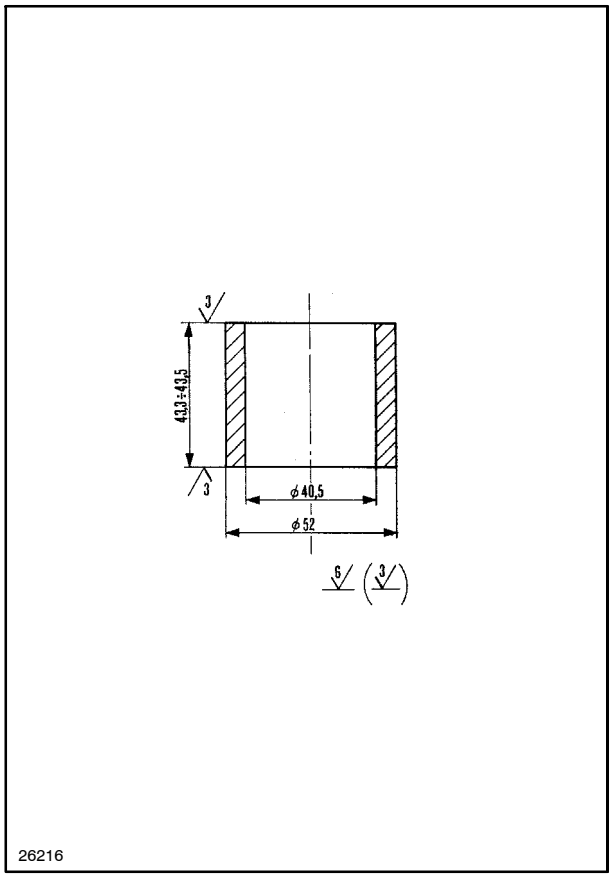
Tool to make for adjusting the assembly position of the bevel pinion shaft
(Mark tool with no. 50004 - Measurements in mm)
Make using Aq 45 material.

Punch to make for gearbox driving shaft disassembly (mark part with no. 50006 - Measurements in mm).
Make in UNI C40 material.

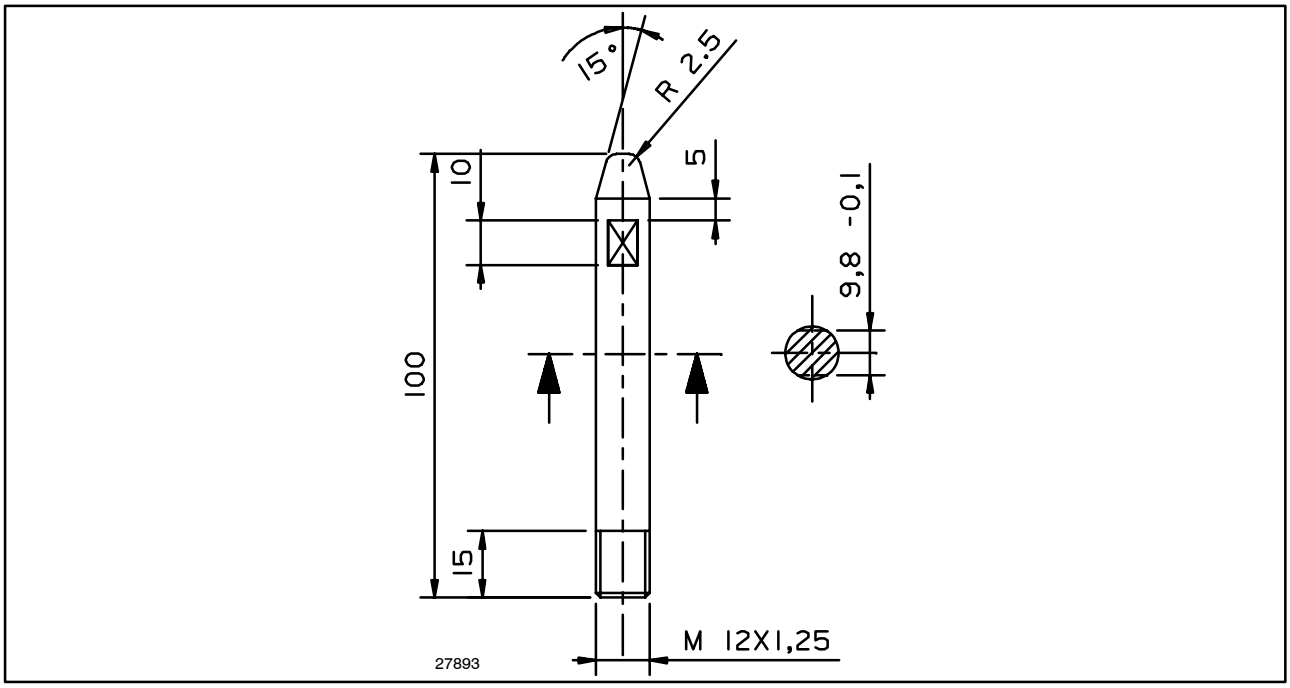


5

Tool to make for adjusting the gearbox driving shaft bearings (mark part with No. 50007 - Measurements in mm).
Make using Aq 45 material.

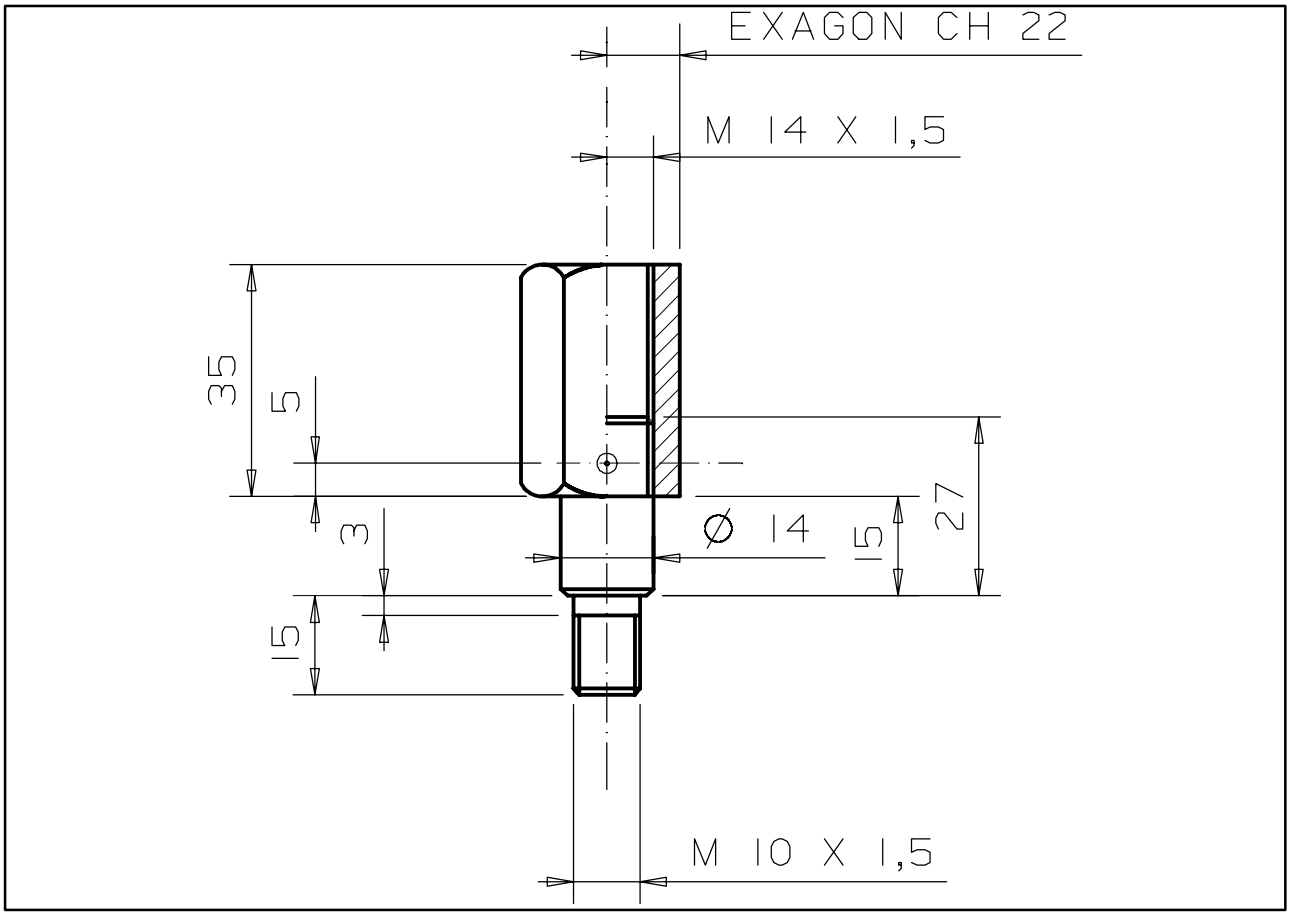


6



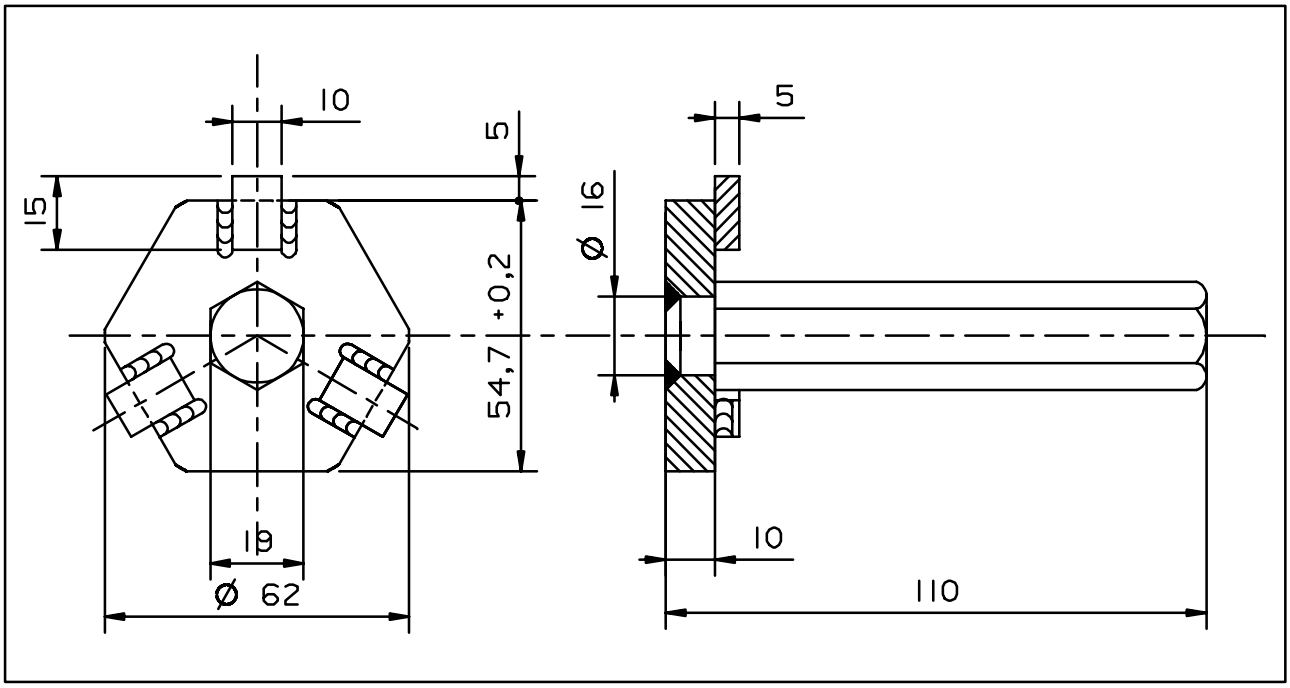
7

Tool to make for front axle reduction unit cover disassembly-assembly
(mark tool with no. 50169 - Measurements in mm)
Make in UNI C40 material



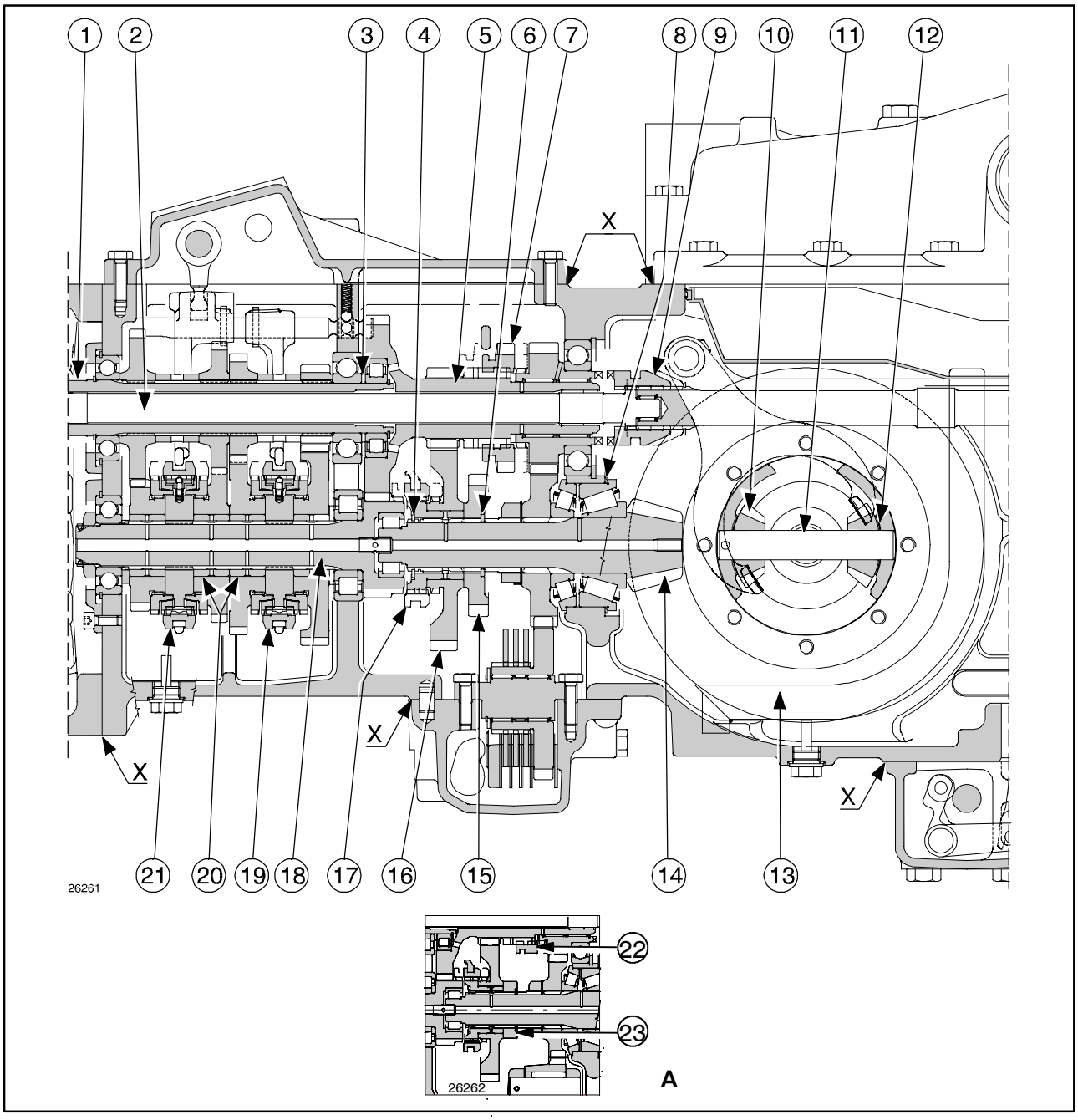
8

Tool to make for bevel pinion extraction
(Mark part with No. 50144 - Measurements in mm)
Make in UNI C40 material. Spring pin 0.1181 x 0.7874 in. (3 x 20 mm).



9

Tool to make for adjusting the bevel drive
(mark tool with no. 50027 - Measurements in mm)
Make in Fe 42 C material.

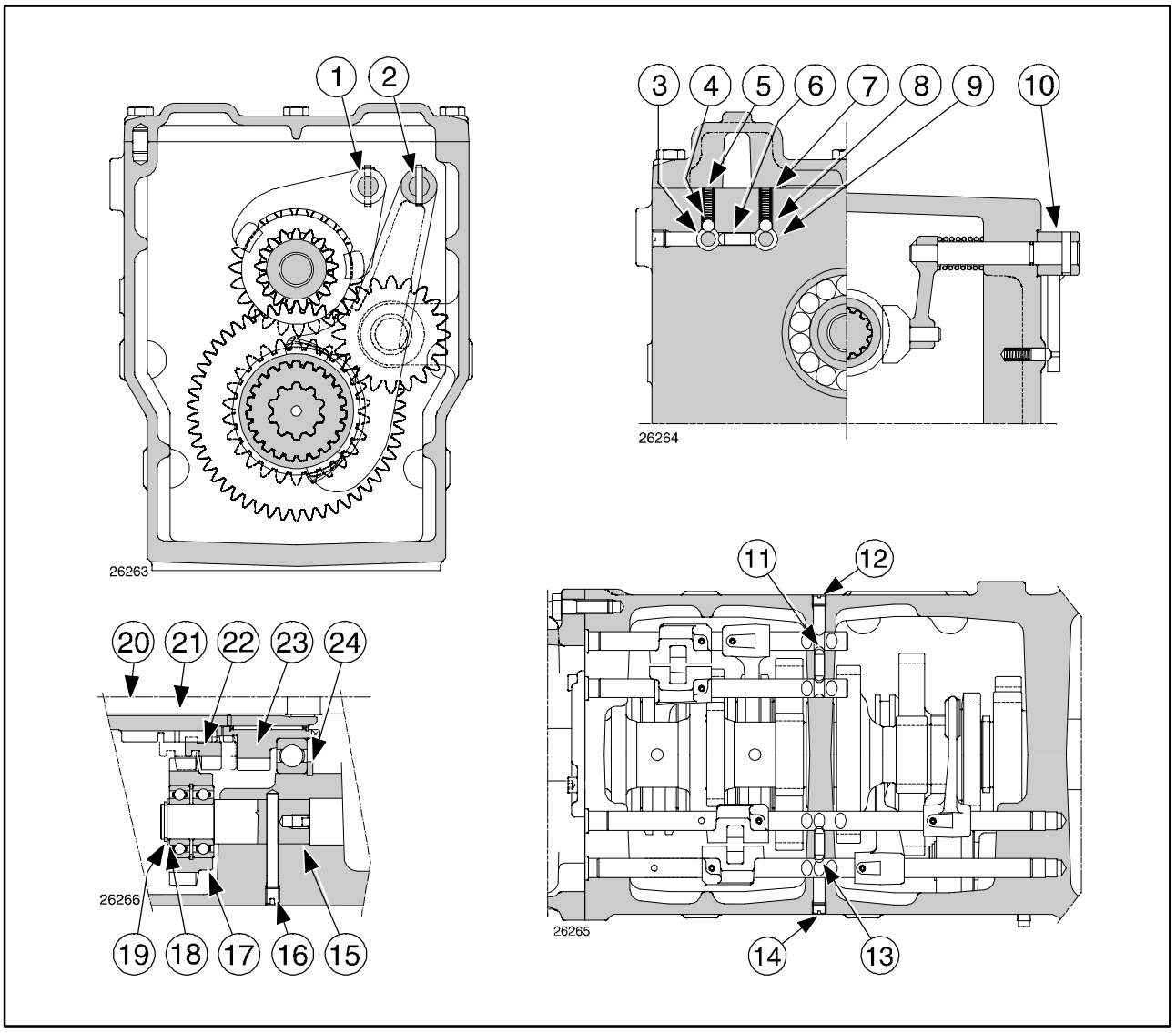


10

Longitudinal section of gearbox-transmission

A. Detail of reduction unit for tractors with reverser.
1. Gearbox driving shaft.
2. PTO control shaft.
3. Adjustment shim for driving shaft clearance.
4. Circlip.
5. Reduction unit driving shaft.
6. Stop half rings.
7. Mid and reverse gear engagement/disengagement.
8. Thickness of bevel pinion position adjustment spacer.
9. PTO engagement sleeve.
10. Planet gear.
11. Pin.
12. Shim ring.
13. Bevel crown wheel.
14. Bevel pinion shaft.
15. Reverse driven gear.
16. Low gear driven gear.
17. Low and high gear engagement sleeve.
18. Gearbox driven shaft.
19. 1st and 2nd gear engagement synchroniser.
20. Gearbox driven gear support bushings.
21. 3rd and 4th gear engagement synchroniser.
22. Mid gear engagement sleeve.
23. Spacer.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *as shown in fig. 85.*

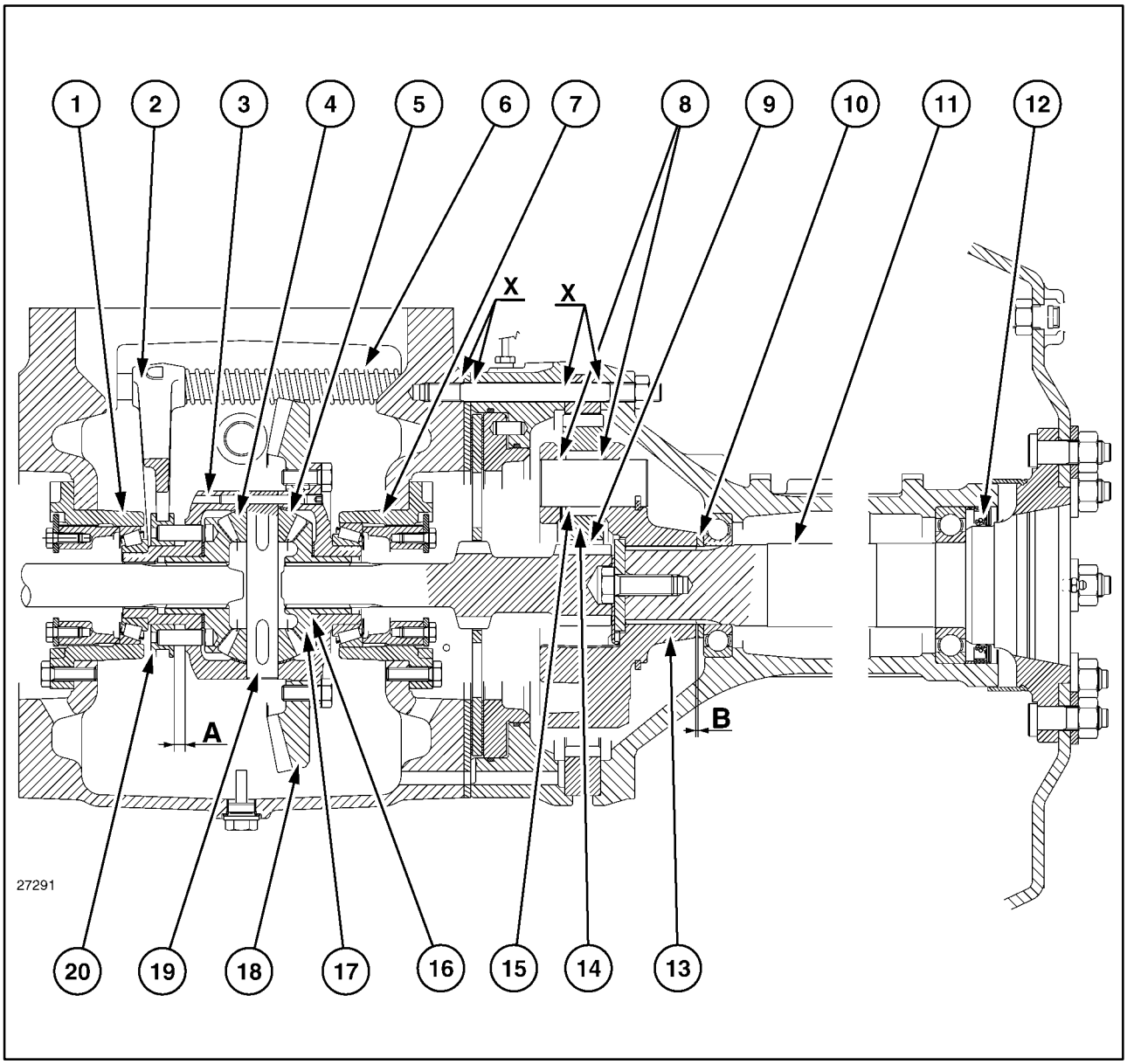


11

Transmission-gearbox cross-sectional views

1. Mid and reverse gear control rod.
2. Low and high gear control rod.
3. Control rods for 1st and 2nd speed.
4. Poppet balls.
5. Spring for ball (4).
6. Gear engagement safety pawl.
7. Spring for ball (8).
8. Poppet ball.
9. Control rod for 3rd and 4th speed.
10. PTO external lever.
11. Gear engagement safety pawl.
12. Plug.
13. Range engagement safety pawl.
14. Plug.
15. Reverse gear support pin.
16. Retaining bolt.
17. Reverse gear intermediate gear.
18. Thrust washer.
19. Circlip.
20. Power take-off shaft.
21. Reverser driving shaft.
22. Mid and reverse gear engagement gear.
23. Mid speed driving gear.
24. Circlip.

NOTE: *Tighten the plugs (12 and 14) using one of the sealing compounds listed on page 1, Section 00.*

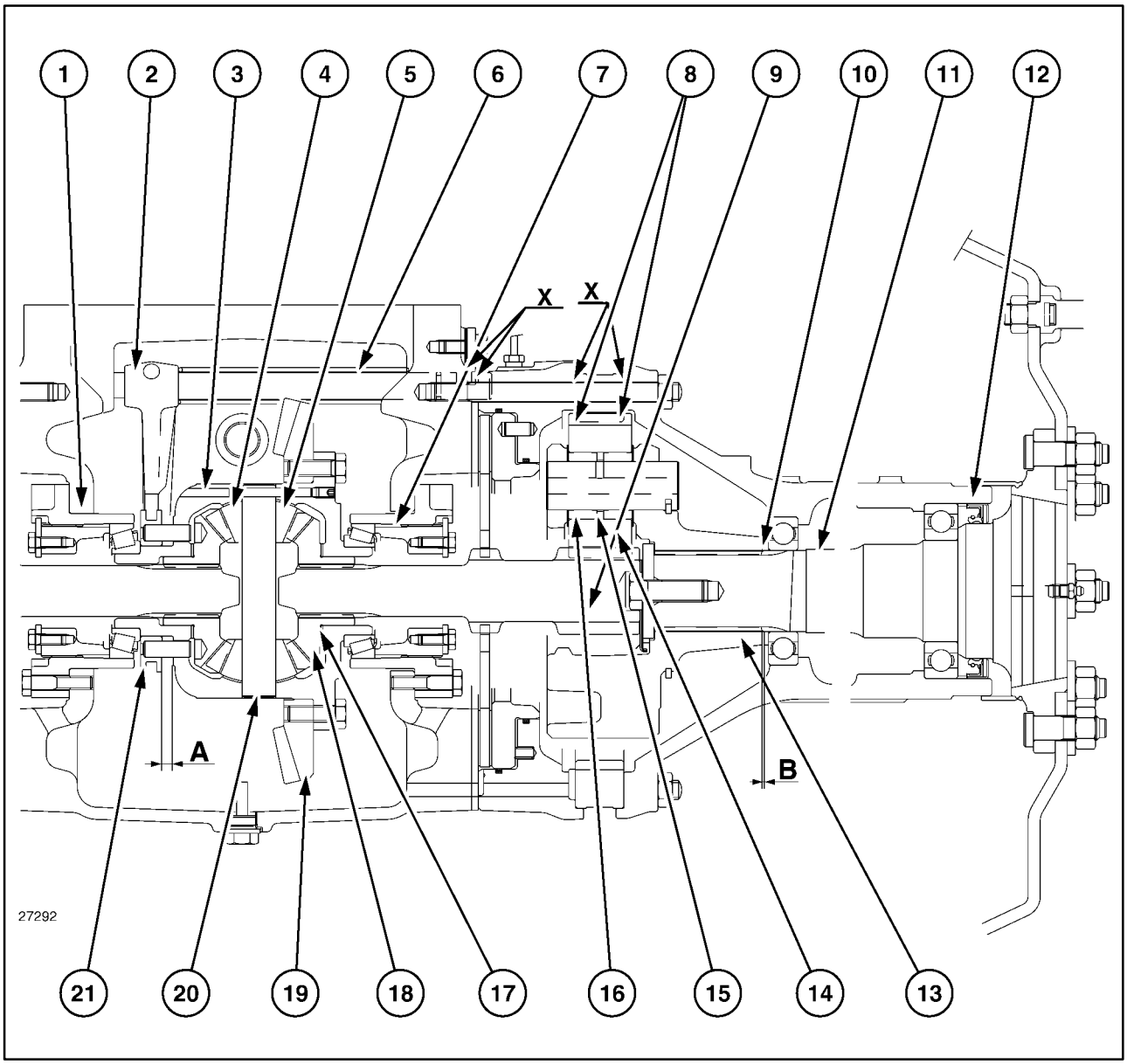


12

Cross-sectional view of transmission (model TL70)

A. 0.3188 to 0.3228 in. (8.1 to 8.2 mm). Differential lock engage sleeve travel.
B. 0.0078 to 0.0157 in. (0.2 to 0.4 mm). Final drive planet pinion support end float.
1. Bevel crown wheel bearing support with adjusting ring nut.
2. Differential lock control fork.
3. Differential casing.
4. Shim ring.
5. Planet gear.
6. Differential lock spring.
7. Bevel crown wheel bearing support.
8. Shim rings.
9. Differential output half-shaft.
10. Planet gear support (13) end float adjuster shim.
11. Wheel axle shaft.
12. Seal.
13. Final drive planet gear support.
14. Final drive planet gear.
15. Bearing.
16. Sun gear clearance adjuster ring.
17. Sun gear.
18. Bevel crown wheel.
19. Planet gear pin (5).
20. Differential lock engagement sleeve.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *as shown in fig. 85.*

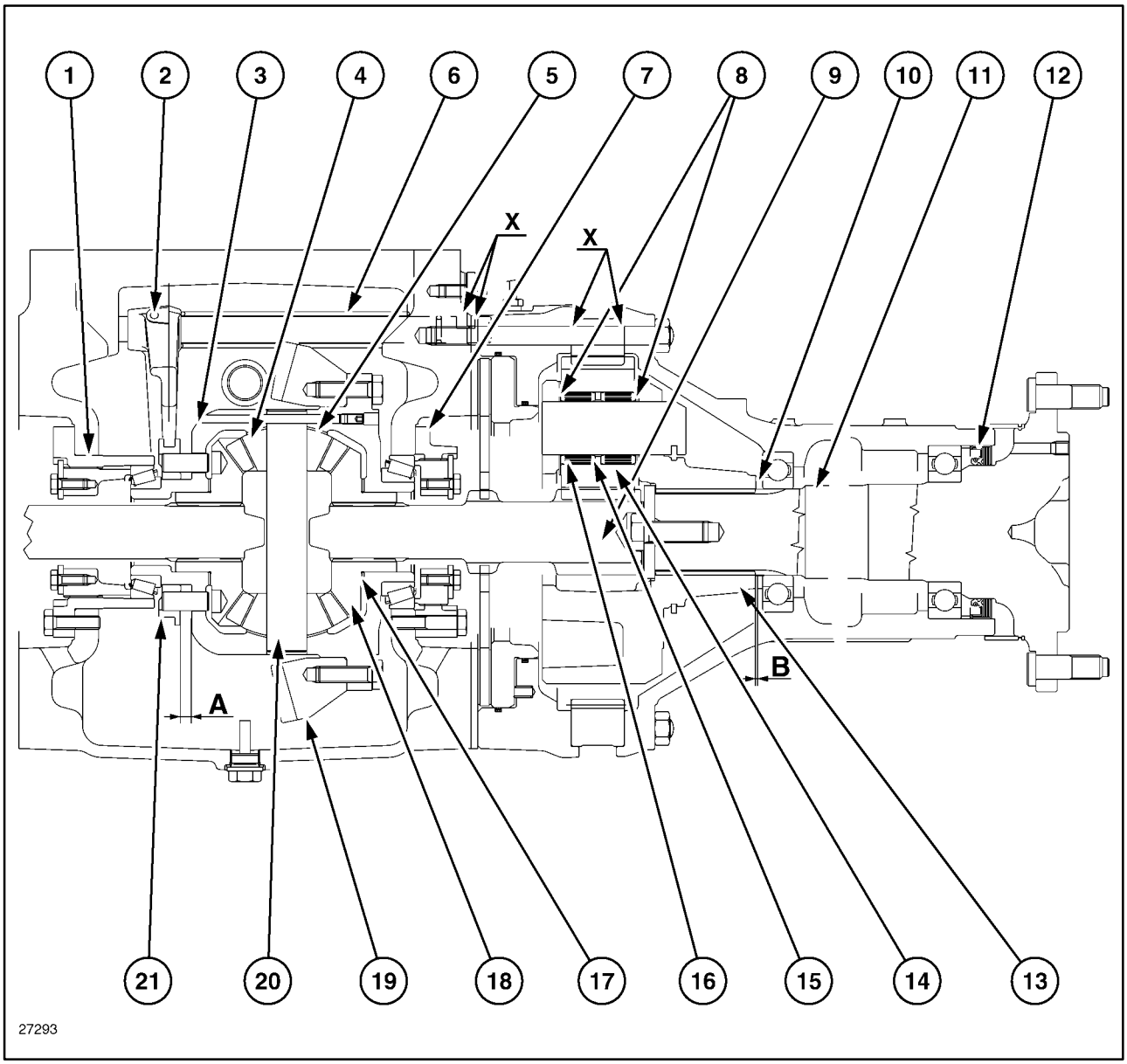


13

Cross-sectional view of transmission (models TL80 and TL90)

A. 0.3188 to 0.3228 in. (8.1 to 8.2 mm). Differential lock engage sleeve travel.
B. 0.0078 to 0.0157 in. (0.2 to 0.4 mm). Final drive planet pinion support end float.
1. Bevel crown wheel bearing support with adjusting ring nut.
2. Differential lock control fork.
3. Differential casing.
4. Shim ring.
5. Planet gear.
6. Differential lock spring.
7. Bevel crown wheel bearing support.
8. Shim rings.
9. Differential output half-shaft.
10. Planet gear support (13) end float adjuster shim.
11. Wheel axle shaft.
12. Seal.
13. Final drive planet gear support.
14. Final drive planet gear.
15. Bearing.
16. Spacer.
17. Sun gear clearance adjuster ring.
18. Sun gear.
19. Bevel crown wheel.
20. Planet gear pin (5).
21. Differential lock engagement sleeve.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *as shown in fig. 85.*

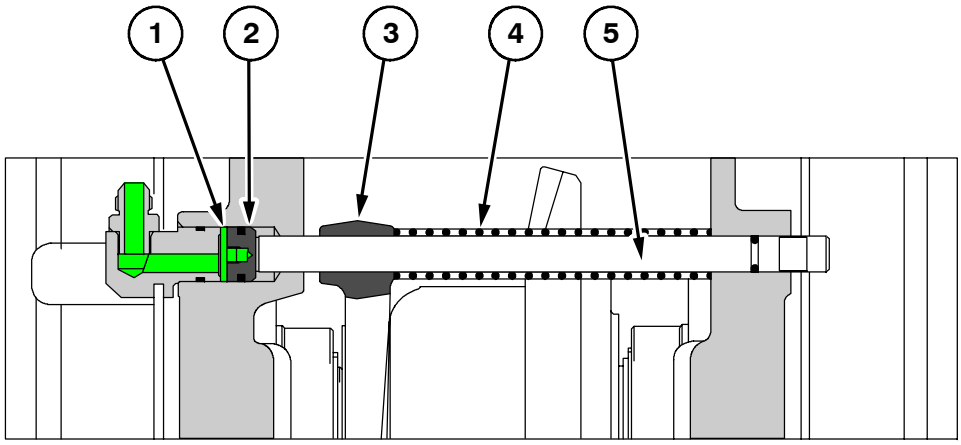


14

Cross-sectional view of transmission (model TL100 and (as an optional) model TL90)

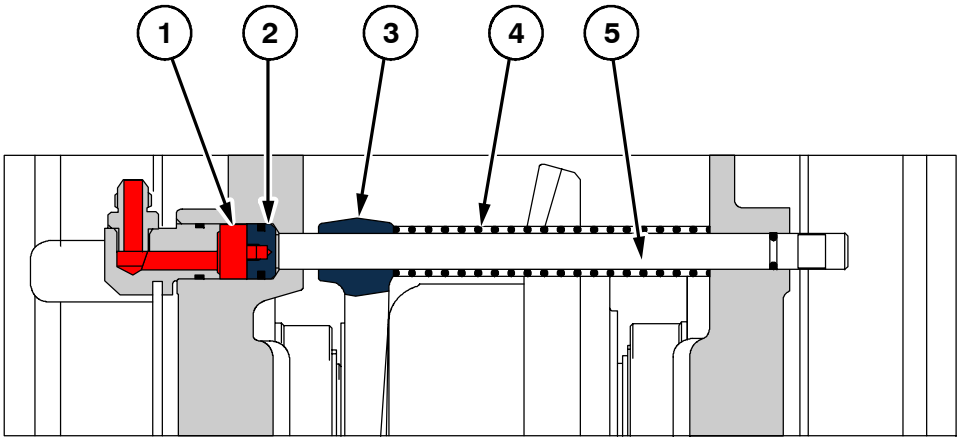
A. 0.3188 to 0.3228 in. (8.1 to 8.2 mm). Differential lock engage sleeve travel.
B. 0.0078 to 0.0157 in. (0.2 to 0.4 mm). Final drive planet pinion support end float.
1. Bevel crown wheel bearing support with adjusting ring nut.
2. Differential lock control fork.
3. Differential casing.
4. Shim ring.
5. Planet gear.
6. Differential lock spring.
7. Bevel crown wheel bearing support.
8. Shim rings.
9. Differential output half-shaft.
10. Planet gear support (13) end float adjuster shim.
11. Wheel axle shaft.
12. Seal.
13. Final drive planet gear support.
14. Final drive planet gear.
15. Bearing.
16. Spacer.
17. Sun gear clearance adjuster ring.
18. Sun gear.
19. Bevel crown wheel.
20. Planet gear pin (5).
21. Differential lock engagement sleeve.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *as shown in fig. 85.*



26269

Rear differential lock disengaged



26270

Rear differential lock engaged

Pressurized oil

Discharge oil

15

DESCRIPTION AND OPERATION

The rear transmission transmits drive from the gearbox to the final drives by means of the bevel drive, the teeth on the bevel drive are helical supported on tapered roller bearings.
The differential has two planet gears and is fitted with a mechanically or hydraulically operated differential lock. Operation of this device is described below.
The final drives are of the epicyclical type and are operated by the bevel drive output half shafts, the same shafts that control the service brakes.

HYDRAULICALLY CONTROLLED REAR DIFFERENTIAL LOCK

When the differential lock is not being used, it is held in the disengaged position by the pressure of the spring (4) on the fork (3).
By operating the relative switch on the control panel, the solenoid valve opens to allow the oil sent from the pump to enter the chamber (1). After acting on the piston (2) and spring (4), it moves rod (5), fork (3) and the sleeve, thereby engaging the differential lock. When the switch is pressed to disengage the differential lock, spring (4) exerts a force on fork (3), rod (5) and piston (2), which discharges the oil through the corresponding solenoid valve.

BEVEL DRIVE AND DIFFERENTIAL TROUBLESHOOTING

Problems	Possible Causes	Solutions
Transmission is noisy while the tractor is moving, even when the gears are in neutral (not due to Final drives).	1. Incorrect adjustment of bevel pinion and / or bevel crown wheel bearings.	Remove the rear transmission casing and correctly adjust the bevel crown wheel and pinion support bearings (page 49).
	2. Incorrect adjustment or wear of sun and planet gears.	Remove the rear transmission casing, replace the worn parts and correctly adjust the differential gears (page 56).
	3. Excessive clearance between half-shaft keyed groove and sun gears.	Remove the rear transmission casing and replace the damaged parts.
Transmission is noisy when tractor is under or released from load.	1. Excessive coupling clearance between the teeth of the pinion and of the bevel crown wheel.	Remove the rear transmission casing and correctly adjust the bevel crown wheel and pinion support bearings (page 49).
	2. Internal part faulty.	Remove the rear transmission casing, replace the worn parts and correctly adjust the differential gear clearance (page 56).
Transmission is noisy and assembly overheats.	1. Pinion and / or bevel crown wheel support bearing clearance insufficient.	Remove the rear transmission casing and correctly adjust the bevel crown wheel and pinion support bearings (page 49).
	2. Insufficient coupling clearance between the teeth of the pinion and of the bevel crown wheel.	Remove the rear transmission casing and correctly adjust the bevel crown wheel support bearings (page 52).

FINAL DRIVE FAULT DIAGNOSIS

Problems	Possible Causes	Solutions
Final drives are noisy while the tractor is moving, even when the gears are in neutral.	1. Incorrect adjustment of wheel axle shaft support bearings.	Remove the final drive casing and adjust the bearings (page 62).
	2. Internal part faulty.	Remove the final drive housing and replace the damaged parts.
	3. Excessive clearance between wheel axle shaft spline and epicyclic final drives.	Remove the final drive housing and replace the damaged parts.

HYDRAULICALLY CONTROLLED DIFFERENTIAL LOCK TROUBLESHOOTING

Problems	Possible Causes	Solutions
The differential lock fails to engage.	1. Transmission oil level insufficient.	Top up oil level.
	2. Clogged oil filter.	Replace filter.
	3. Hydraulic pump faulty.	Overhaul or replace pump.
	4. Differential lock control switch faulty.	Replace switch.
	5. No power at solenoid valve: connections loose or damaged, contactor defective.	Check electrical connections and replace defective parts.
	6. Differential lock control solenoid valve jammed in discharge position.	Overhaul or replace solenoid valve.
	7. Oil leakage through seals, leading to drop in pressure: cylinder piston or feed pipe seals.	Replace all defective seals.
Differential lock fails to disengage.	1. Differential lock engage/release switch faulty.	Replace switch.
	2. Differential lock solenoid valve jammed in delivery position.	Overhaul or replace solenoid valve.
	3. Disengage spring faulty.	Remove the hydraulic lift and replace the spring.
With the differential lock engaged and the control switch in the automatic position, the differential lock does not disengage when the lift arms are raised with the LIFT-O-MATIC device.	1. Differential lock control switch (connected to LIFT-O-MATIC device) defective.	Replace switch.
With the differential lock engaged, it cannot be disengaged by operating the brake pedals.	1. Differential lock control switch (connected to brake pump) defective.	Replace switch.

Op. 21 118 12
REAR GEARBOX-TRANSMISSION CASING R.I.

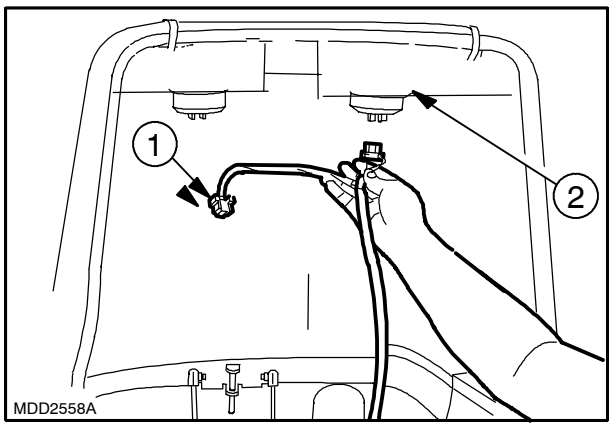
CAUTION

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

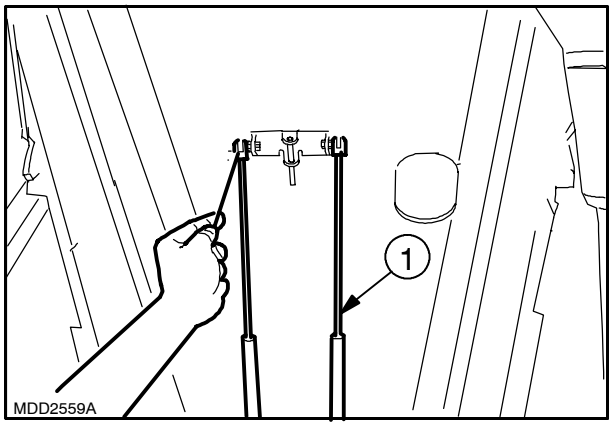
To remove the rear transmission-gearbox casing proceed as follows.

1. Disconnect the battery negative cable.

2. Remove the exhaust pipe, raise the bonnet and disconnect the front headlight (2) connections (1).
3. Detach the gas springs (1) on the bonnet.

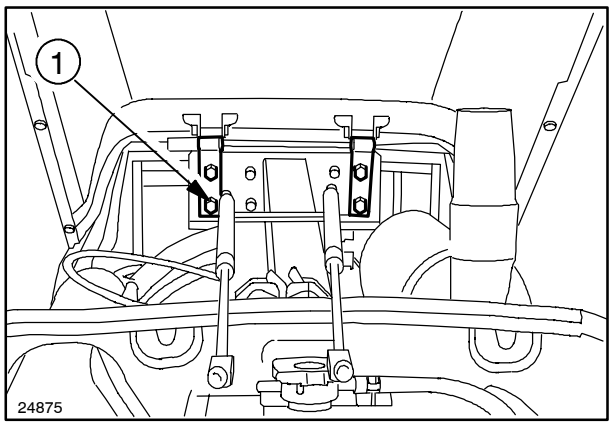


16



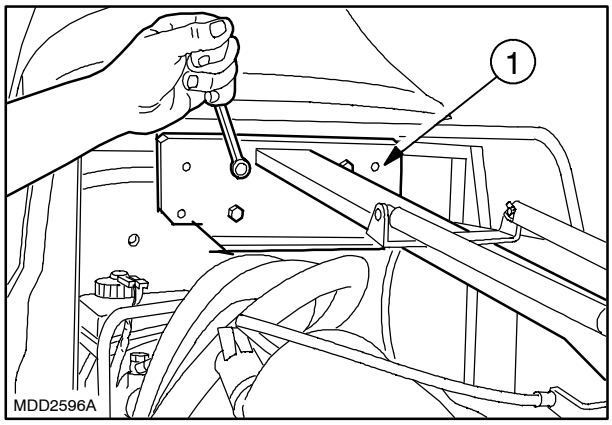
17

4. Unscrew the four bolts (1) retaining the hinge brackets and remove the bonnet.



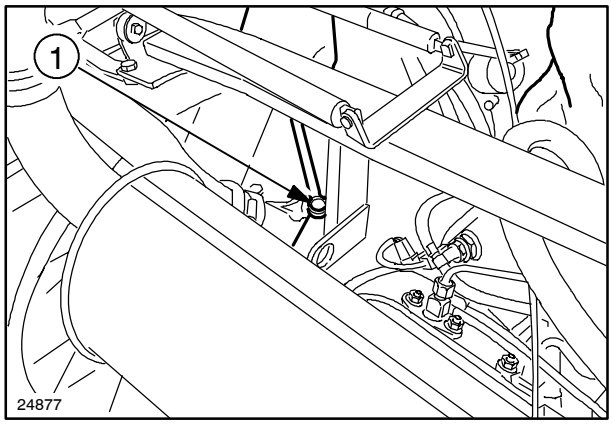
18

5. Remove the bonnet support rear bracket (1) retaining bolts.



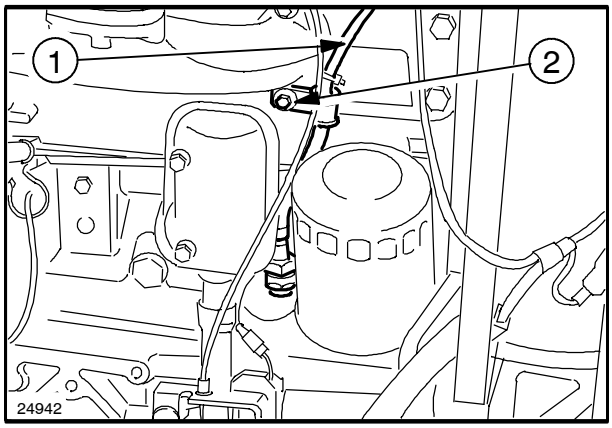
19

6. Remove the bonnet support front bracket retaining bolts (1).
7. Disconnect the main electrical connections.



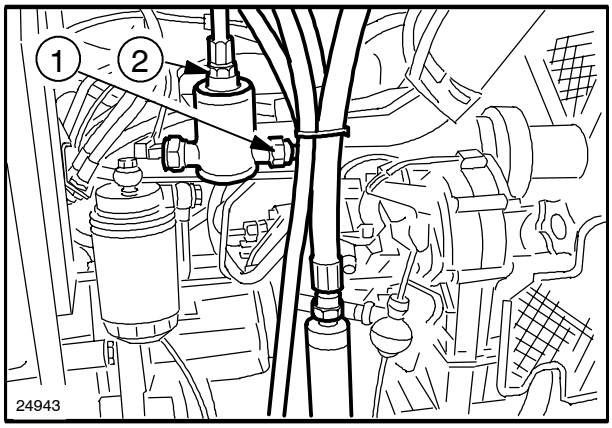
20

8. Disconnect the rev counter (1) cable on the engine and unscrew the bracket retaining bolt (2).



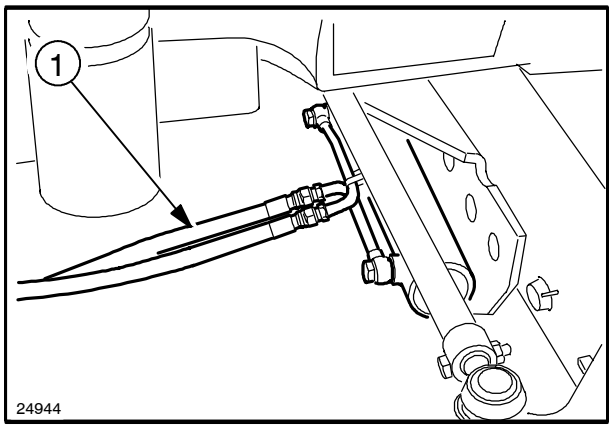
21

9. Disconnect the piping (1 and 2) on the anticavitation tank.



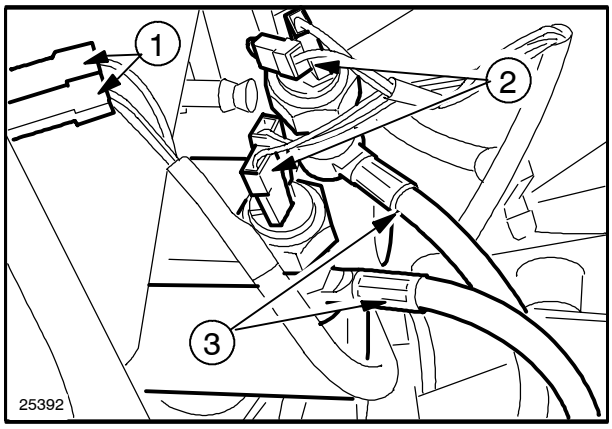
22

10. Disconnect the two hoses (1) from the power steering control cylinder (it is advisable to mark them to help with refitting).



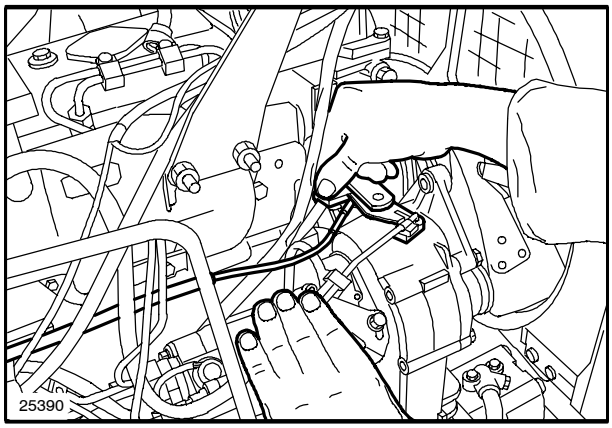
23

11. Disconnect the electrical connections (1 and 2) from the oil tank and from the brake pumps.
12. Disconnect the control pipes (3) from the brake pump removing the pressure gauges.



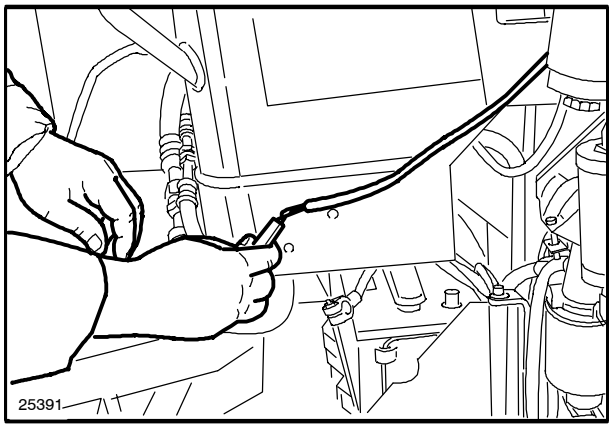
24

13. Disconnect the accelerator cable (1) from the injection pump.



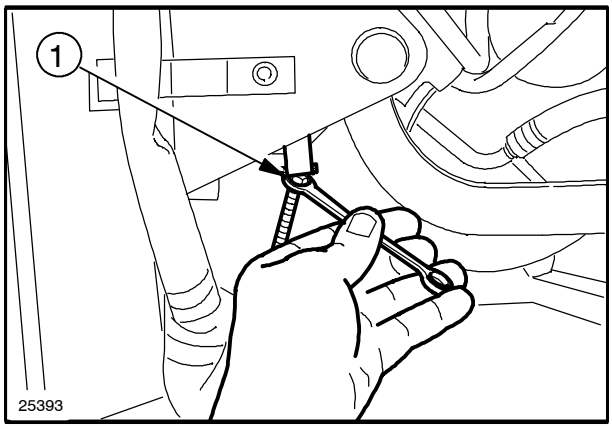
25

14. Disconnect the connections (1) of the indicator and side lights (on both sides of the tractor).



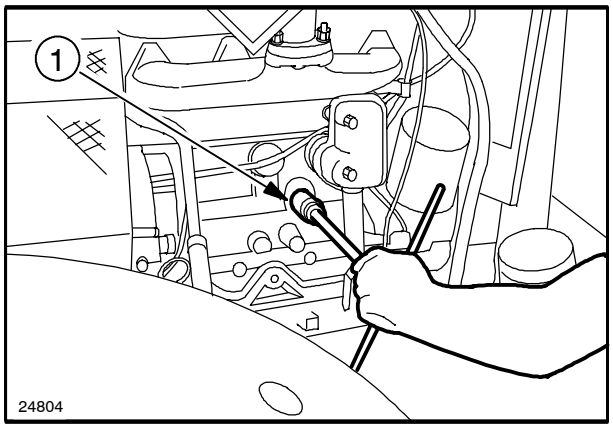
26

15. Remove the knobs and the left-hand guard.
16. Take out the retaining nut and remove the clutch control tie-rod (1), take off the rubber guard and take the tie-rod out of its hole.



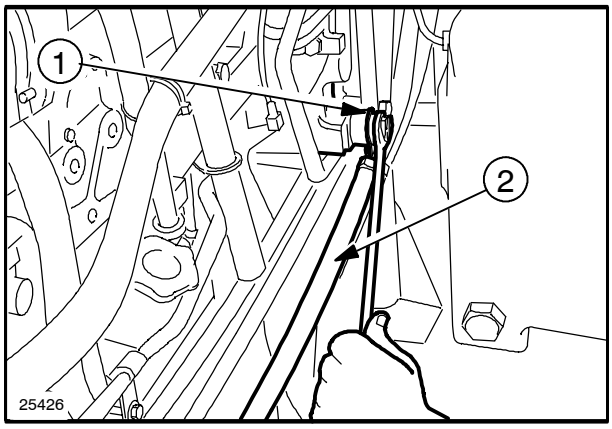
27

17. Drain the coolant from the plug (1) in the crankcase.



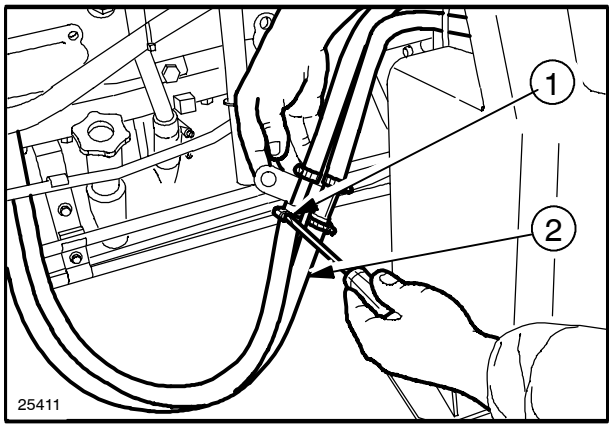
28

18. Take out the bolt (1) securing the cab heating pipe bracket (2).



29

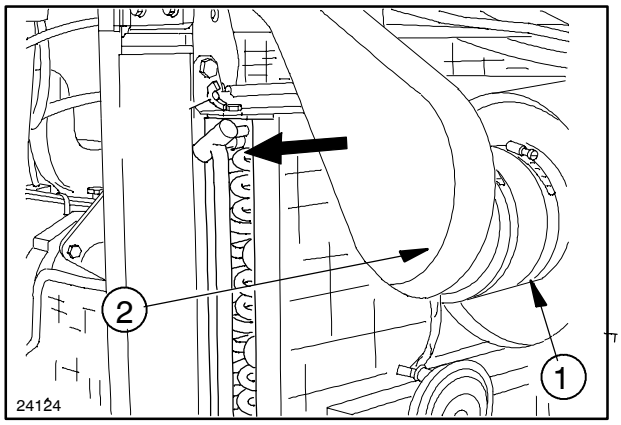
19. Loosen the clamps (1) and disconnect the cab heating piping (2). It is advised to mark the pipes before disconnecting.



30

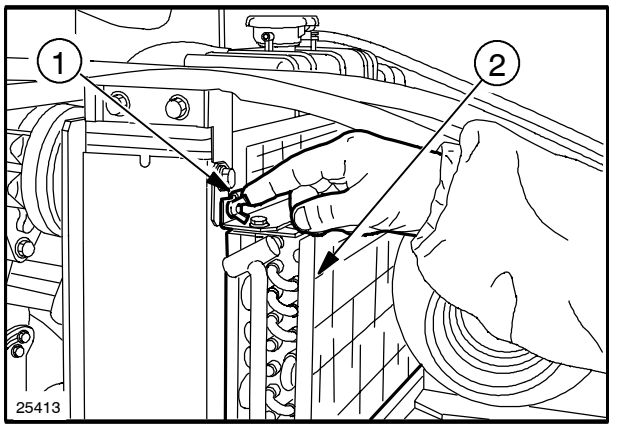
20. Loosen the clamps (1) on the intake manifold or turbocharger, and remove the connecting line (2).

NOTE: *To avoid foreign bodies entering, seal the hole on the manifold or turbocharger.*



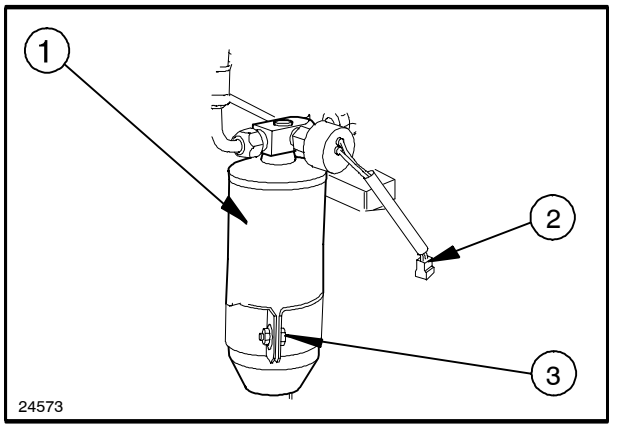
31

21. Unscrew the retaining wing nut (1) on the condenser (2).



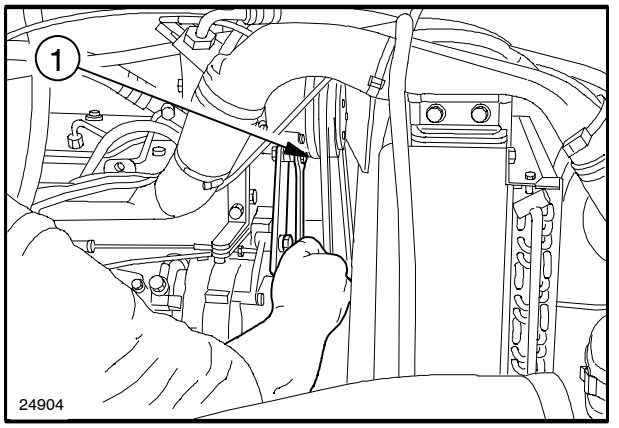
32

22. Disconnect the electrical connection (2), unscrew the bolt (3) securing the filter to the clamp and remove the dehydrator filter (1), located near the compressor.



33

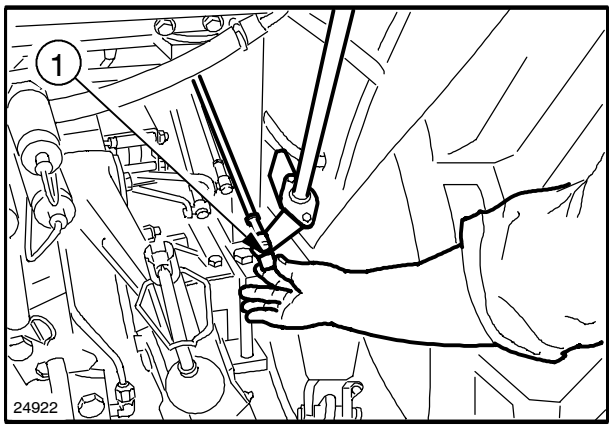
23. Unscrew the bolts (1) securing the compressor and disconnect the ground connection.



34

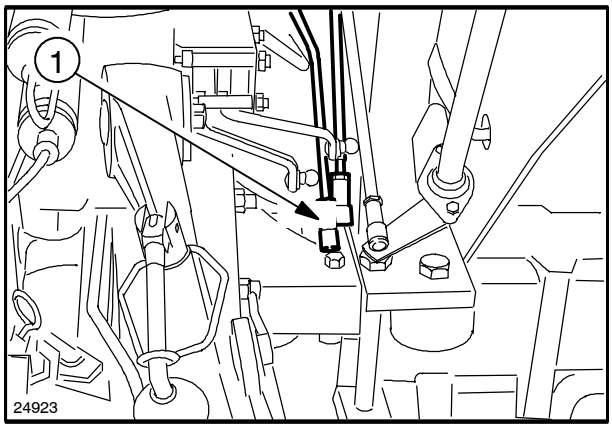
24. Place the previously disconnected compressor (1), condenser (2) and the dehydrator filter inside the cab without disconnecting the piping.

25. Detach the retaining spring (1) and disconnect the lift ground control drive rod.



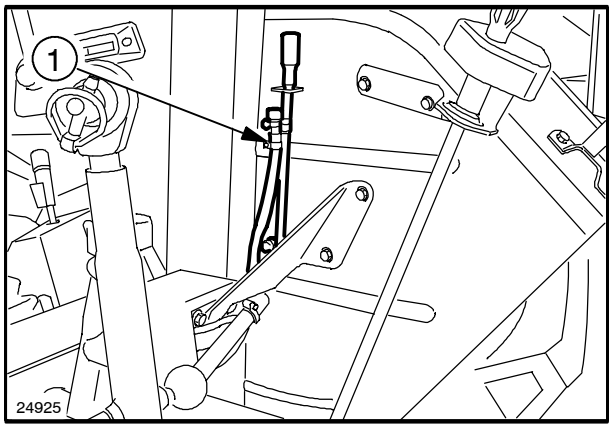
35

26. Remove the retaining springs and detach the two draft and position control rods (1) and, if necessary, also detach from the cab and remove.



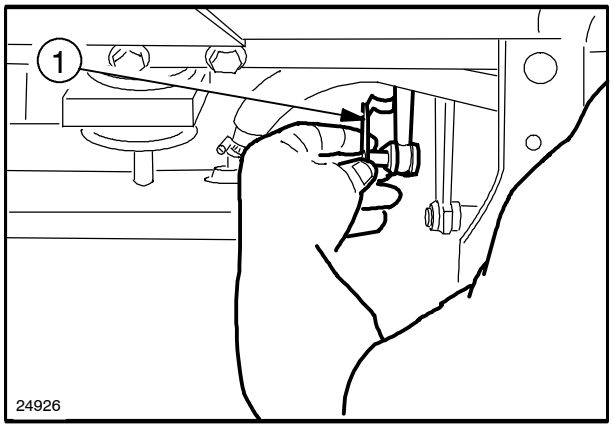
36

27. Unscrew the bolts (1) securing the fuel tank breather pipes and transmission from the mudguard.
28. Detach the auxiliary control valve rods.



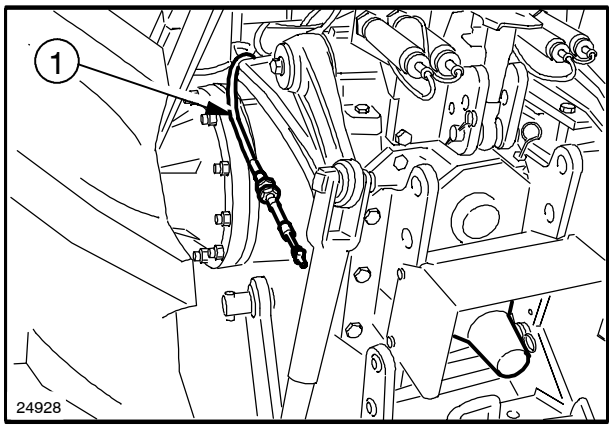
37

29. Detach the retaining springs (1) on the PTO control lever synchronised with the gearbox.
30. Disconnect the Creeper engagement lever.



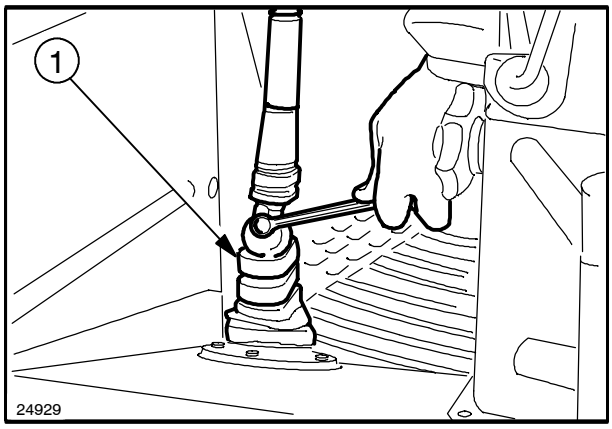
38

31. Remove the tie-rod (1) governing power take-off speed selection.



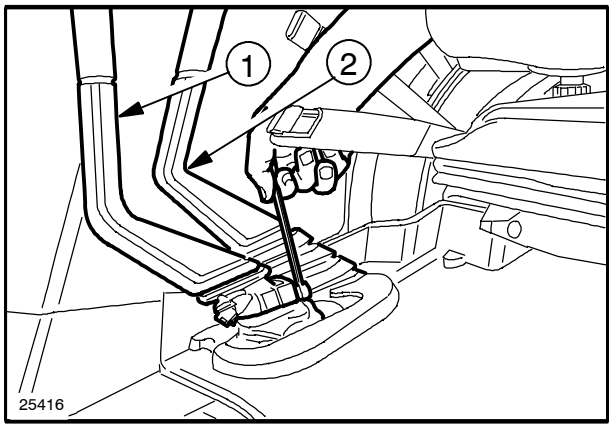
39

32. Slide the dust hood down, unscrew the retaining bolt and detach the reverser control lever (1).



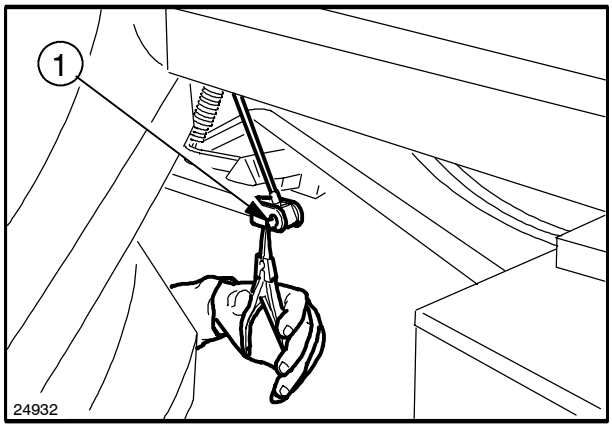
40

33. Lower the dust hood, disconnect the electrical connection on the Dual Command (2 Speed Power Shift), loosen the retaining bolt and detach the gear selection lever (1).
34. Lower the dust hood, loosen the retaining bolt and remove the range selection lever (2).



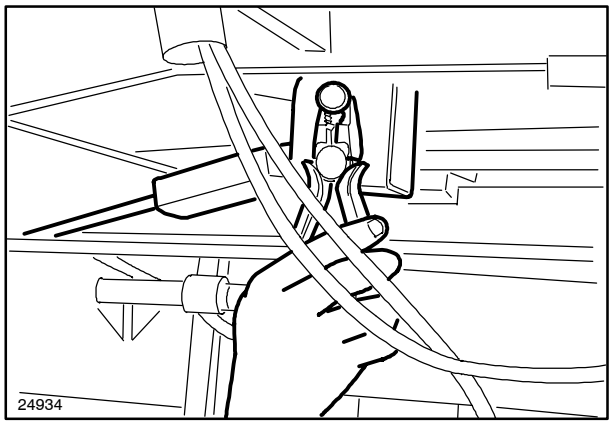
41

35. Remove the snap ring (1), extract the pin and disconnect the parking brake control cable.



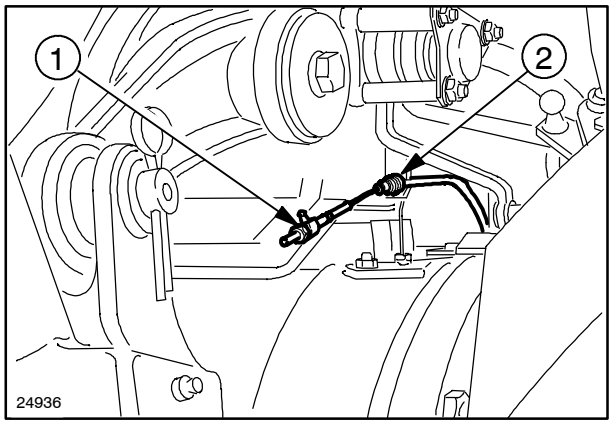
42

36. If a rear mechanical lock is fitted, remove the front and rear split pins and pivot pins from the drive lever and remove.



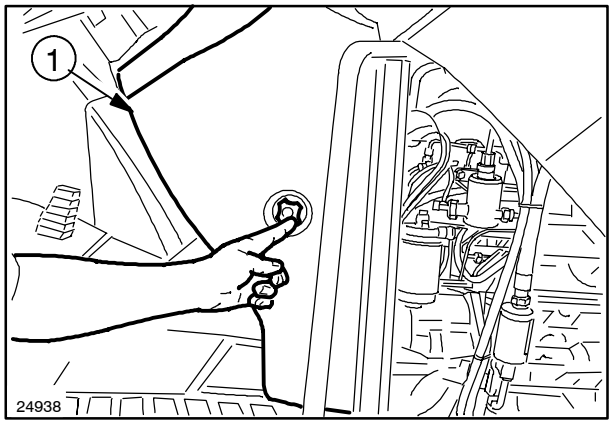
43

37. Remove the Lift-O-Matic control cable (1) from the lever on the lift body and extract it from the bracket (2).



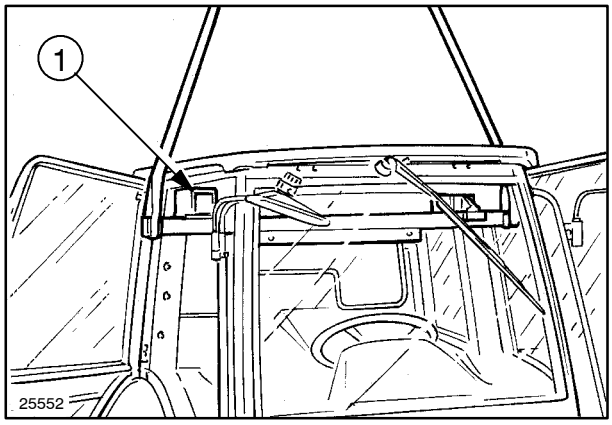
44

38. Remove the knobs and detach the right-hand guard (1); if necessary, detach the accelerator cable from the pedal and remove.



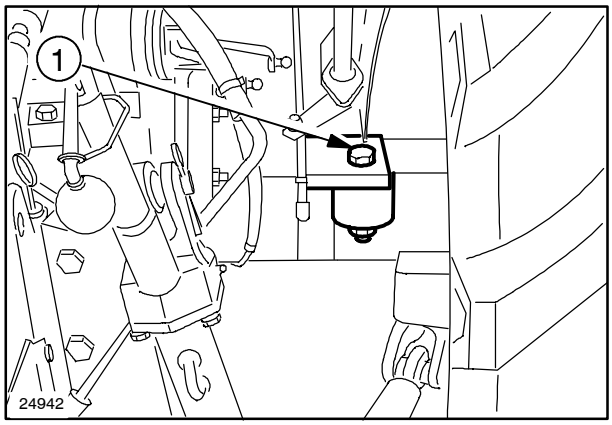
45

39. Position tool **380000294** (1) inside the cab, hitch to a hoist using 2 nylon slings and take up the slack.



46

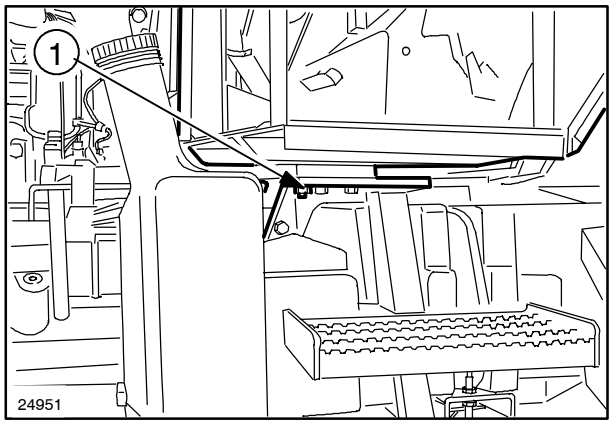
40. Take out the bolts (1) securing the rear of the cab to the final drive (on both sides).



47

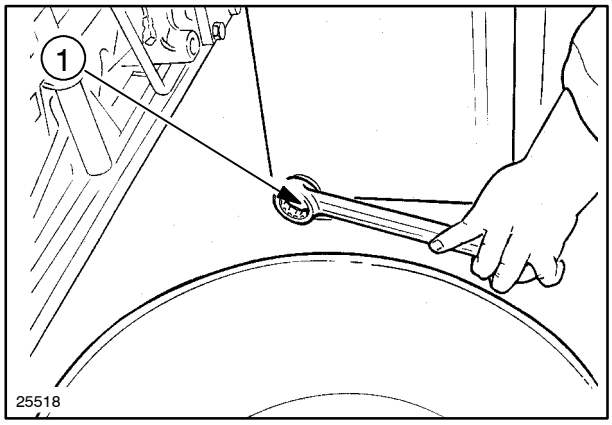
41. Unscrew the front bolt (1) securing the cab to the relative support (carry out this operation on both sides).

42. Slowly raise the cab, making sure that there are no obstructions or connected parts, and position on the flooring on suitable supports.



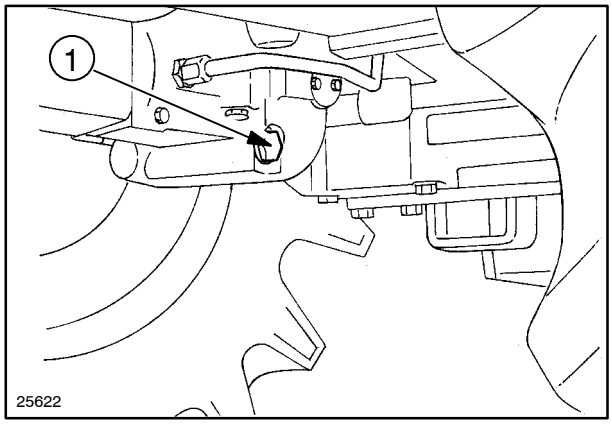
48

43. Remove the plug (1) and drain off the fuel tank into a suitable container [tank capacity is 29.05 gallons (110 litres)].



49

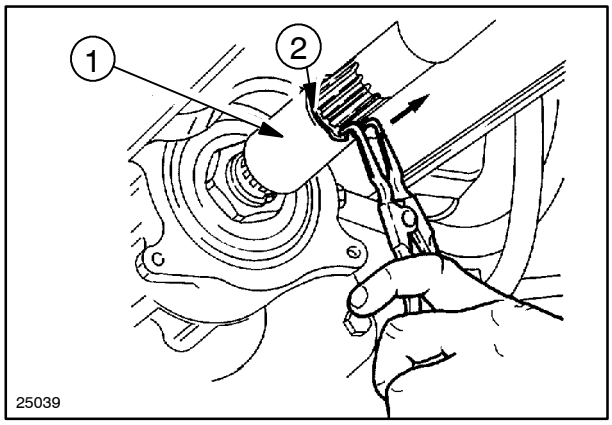
44. Take out the plug (1) and drain oil from the gear-box-transmission casing.



50

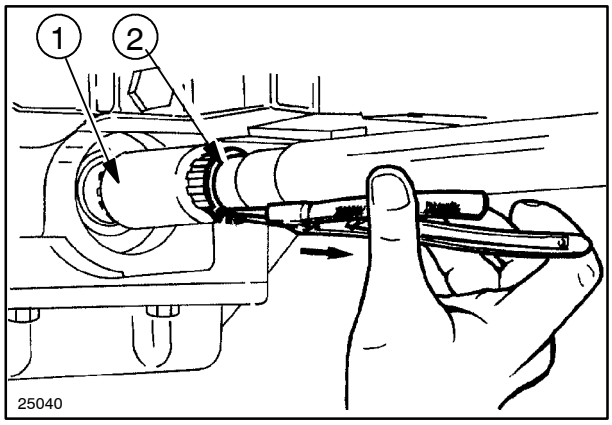
45. Remove the 4WD transmission shaft guard by unscrewing the front, central and rear retaining bolts.

    Take off the circlip (2) and extract the sleeve (1) from the front axle pinion.



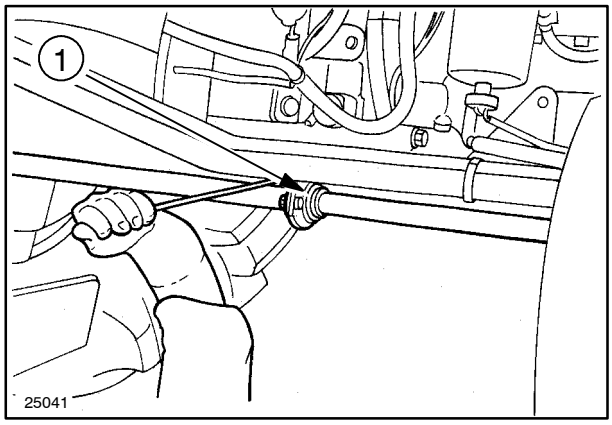
51

46. Take off the circlip (2) and extract the sleeve (1) from the drive.



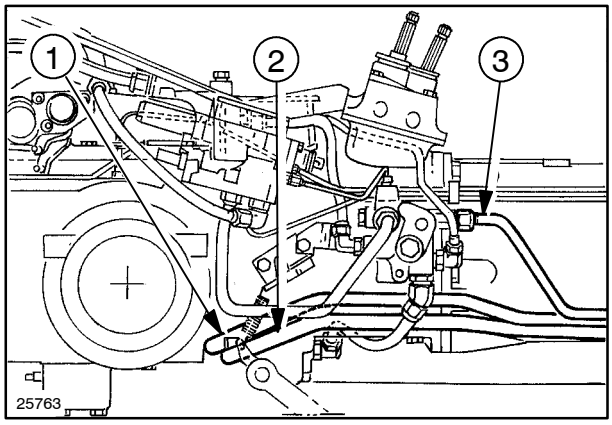
52

47. Remove the propeller shaft central support (1) retaining bolts and extract the shaft together with the support.



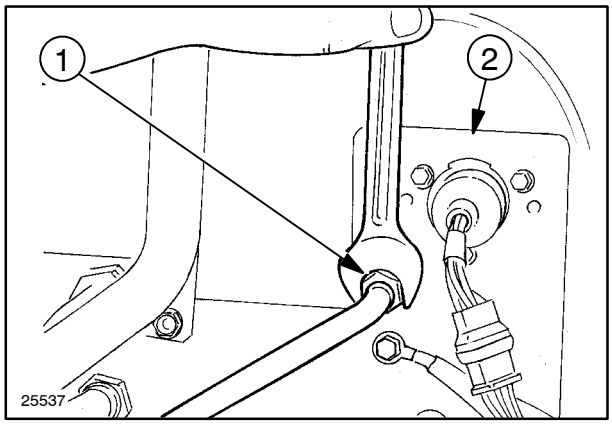
53

48. Detach the oil pump intake lines (1 and 2) on the transmission-gearbox casing. Unscrew the union and remove the pipe (3) for delivery from the pump to the trailer brake control valve.



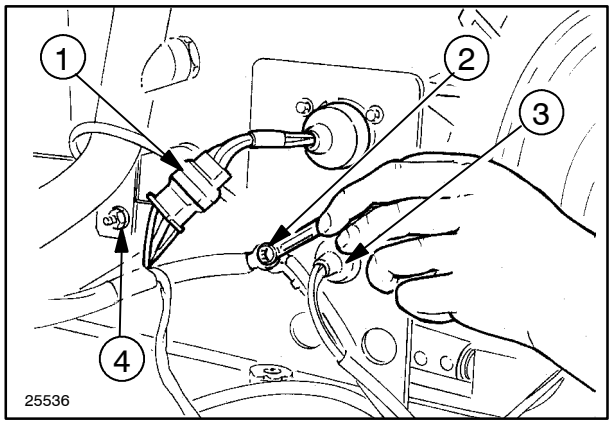
54

49. Remove: the trailer brake control piping (1) and the auxiliary control valve piping from the supporting plate (2).



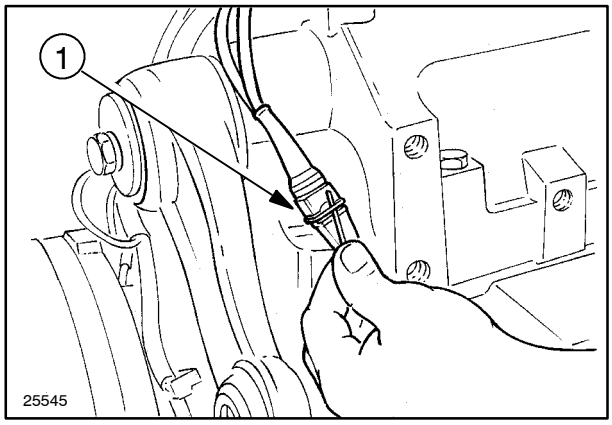
55

50. Disconnect the electrical connection (1) of the seven-pin socket, remove the two-pin socket (3) from its mounting, and unscrew the bolts (2 and 4) to disconnect the ground cables.



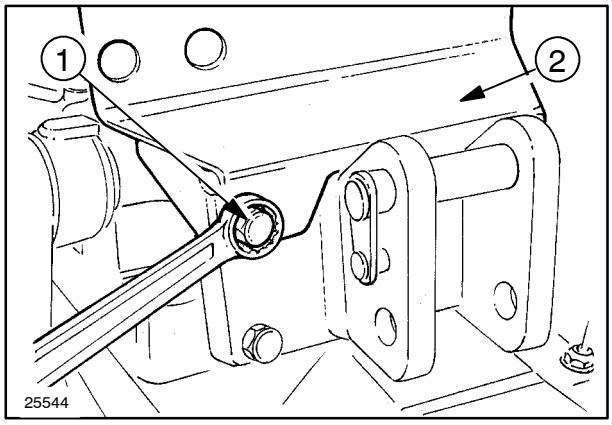
56

51. Disconnect the electrical connection (1) on the PTO rev counter.



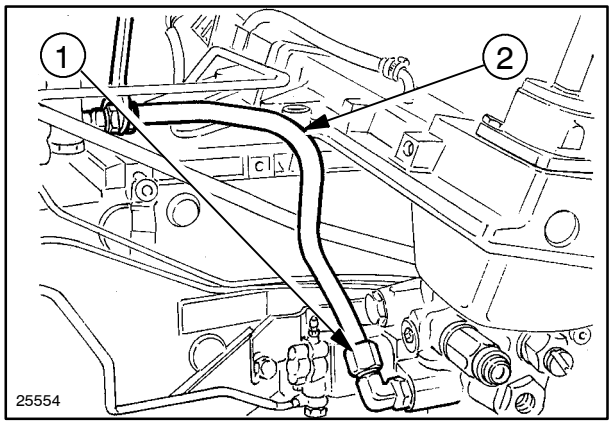
57

52. Take out the bolts (1) securing the three-point linkage support and remove it together with the supporting plate (2).



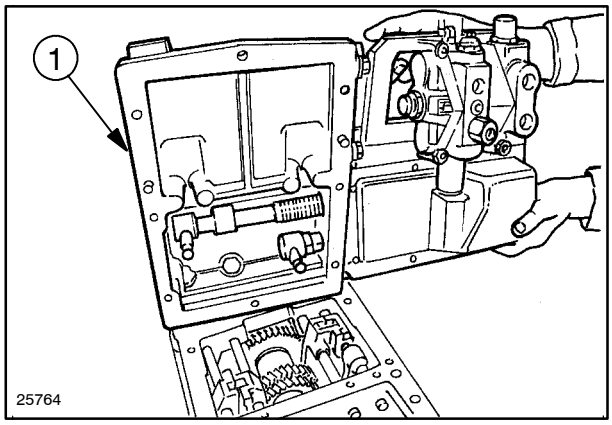
58

53. Remove the unions (1) on the rigid lift control valve feed pipe (2) and remove.



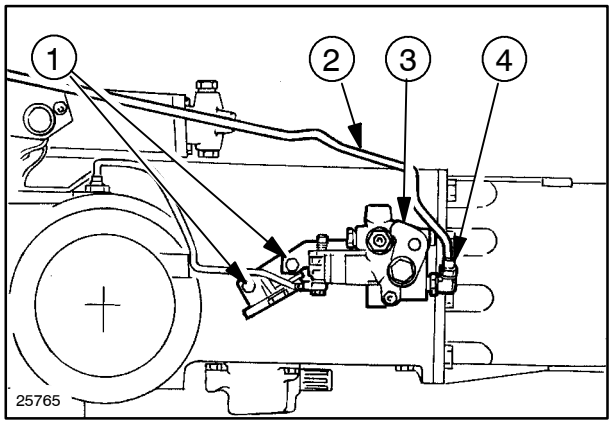
59

54. Unscrew the bolts, raise and remove the cover (1) and transmission-gearbox casing assembly.



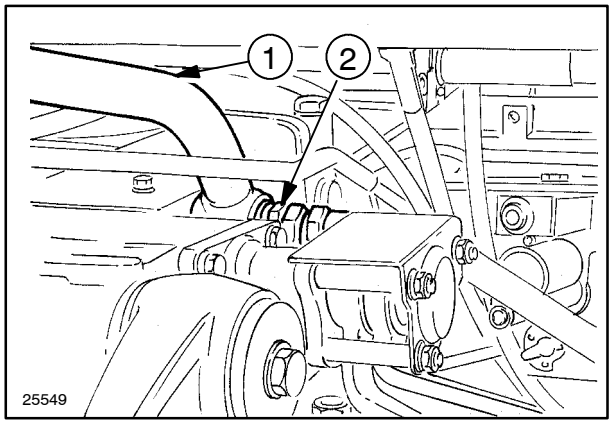
60

55. Remove the union (4) and disconnect the trailer brake control pipe (2); take out the two bolts (1) securing the bracket and remove it together with the trailer brake valve unit (3).



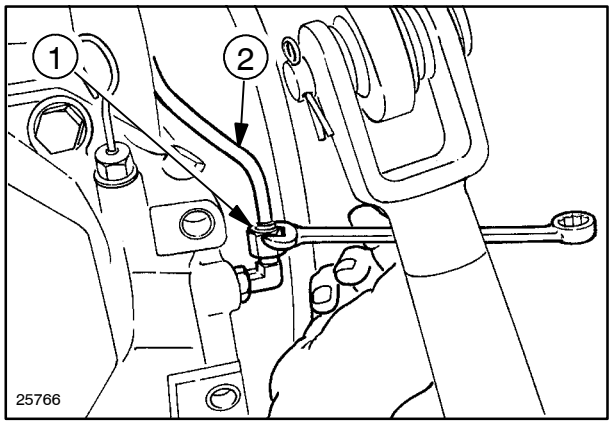
61

56. Remove the union (2) and disconnect the oil top-up pipe (1) in the gearbox-transmission casing.



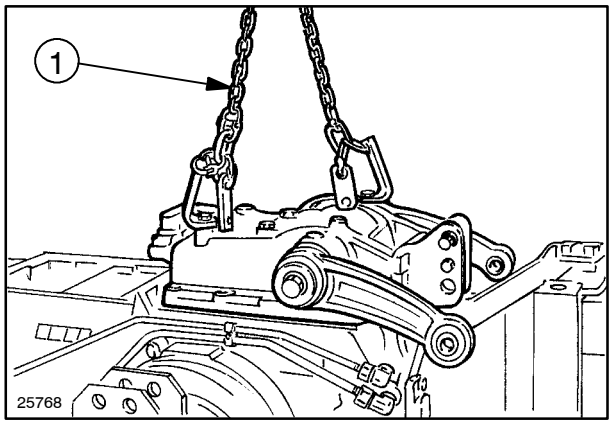
62

57. Remove the union (1) and disconnect the power take-off brake control pipe (2).



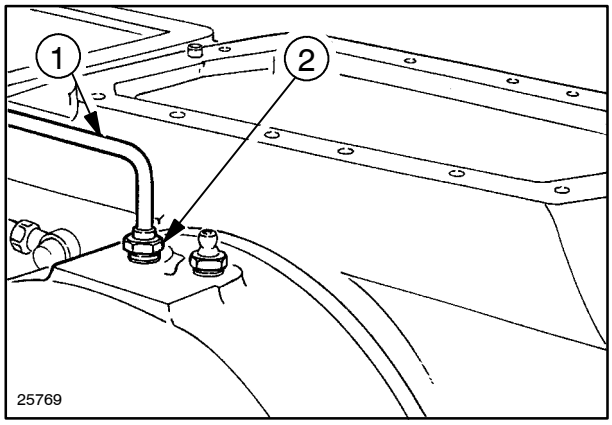
63

58. Take out the retaining bolts and, using hook **380000227** (1), remove the hydraulic lift.



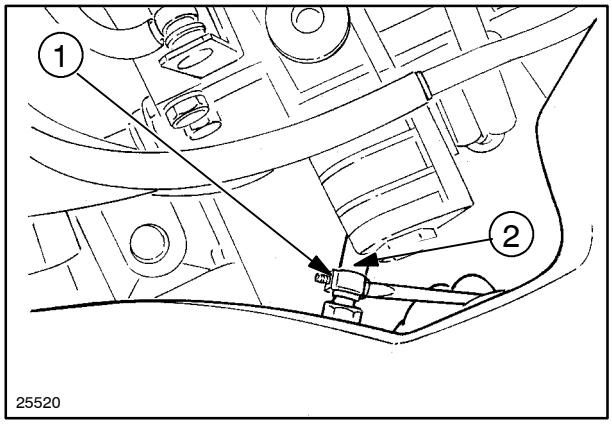
64

59. Remove the union (2) and disconnect the brake control pipe (1); perform this operation on the right-hand side too.



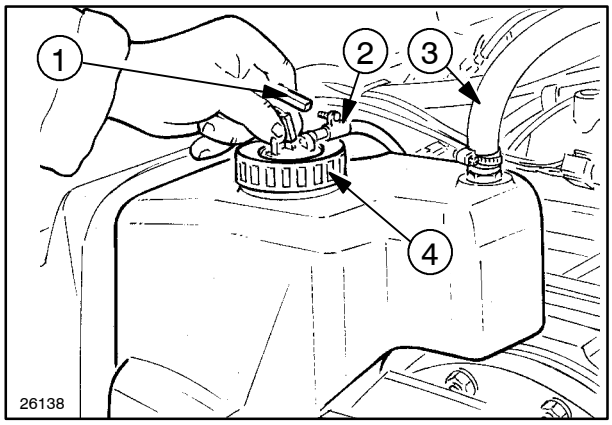
65

60. Take off the clamp (1) and remove the injection pump supply pipe (2).



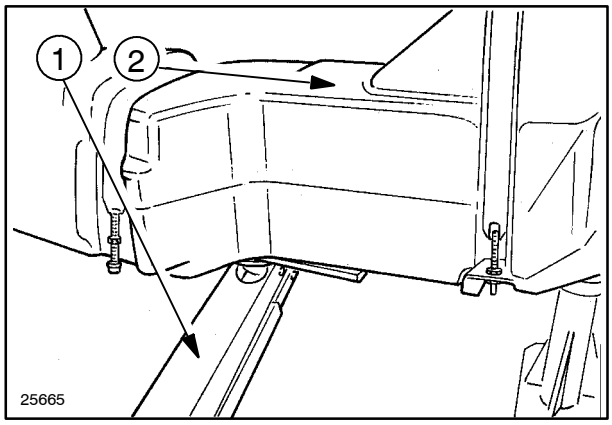
66

61. Disconnect the electrical connections (1) and the fuel return line (2) located on the fuel gauge unit (4) and detach the breather pipe (3).



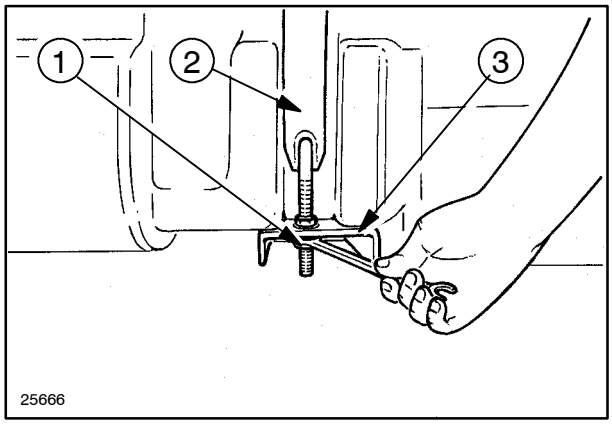
67

62. Position a hydraulic jack (1) under the central part of the tank (2) and slightly raise the tank.



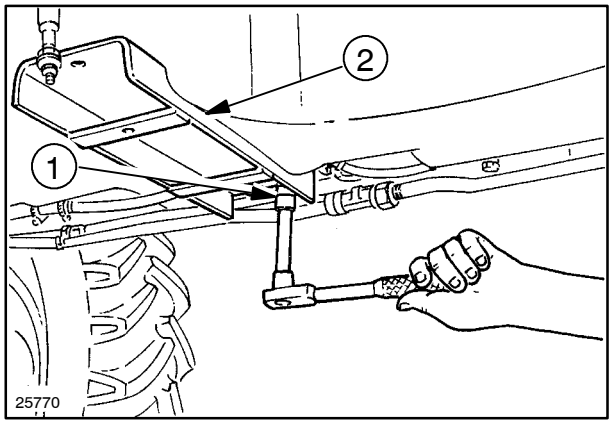
68

63. Unscrew the nut (1) securing the clamp (2) and disconnect it from the supporting bracket (3). Repeat the same operation on the front clamp.



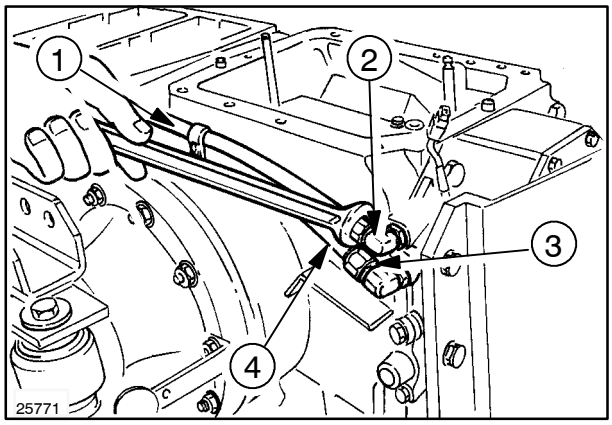
69

64. Take out the bolts (1) and remove the bracket (2) supporting the fuel tank. Repeat the same operation on the front bracket and remove the tank.



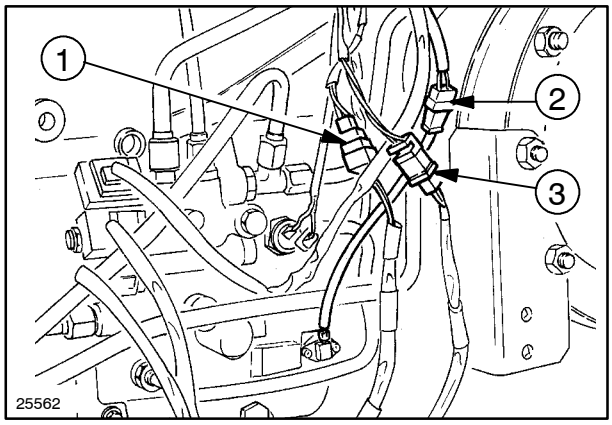
70

65. Remove the union (2) and disconnect the p.t.o. coupling control pipe (1).
Remove the union (3) and disconnect the power take-off lubrication pipe (4).



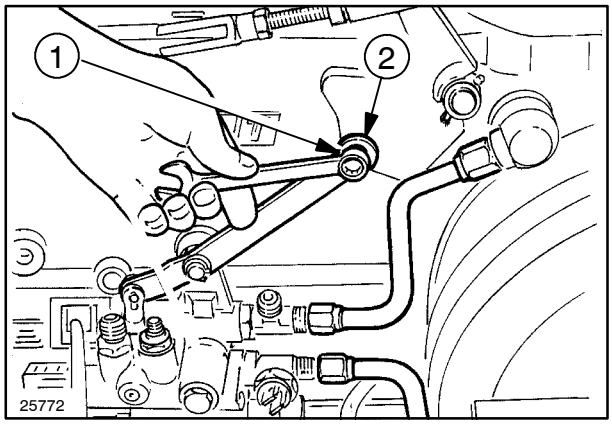
71

66. Mark and disconnect all the electrical connections: solenoid valves (1 and 3): 4WD, PTO and differential lock, 4WD pressure gauge and speed sensor (2).



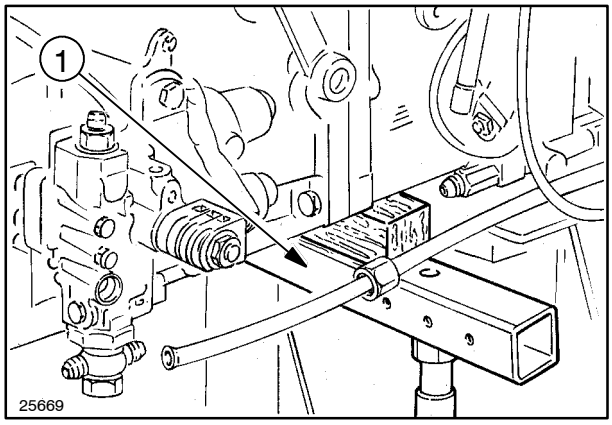
72

67. Disconnect all the lines from the solenoid valve support, unscrew the retaining bolt (1) and detach the solenoid valve exclusion lever (2) with PTO synchronised with engaged gearbox.



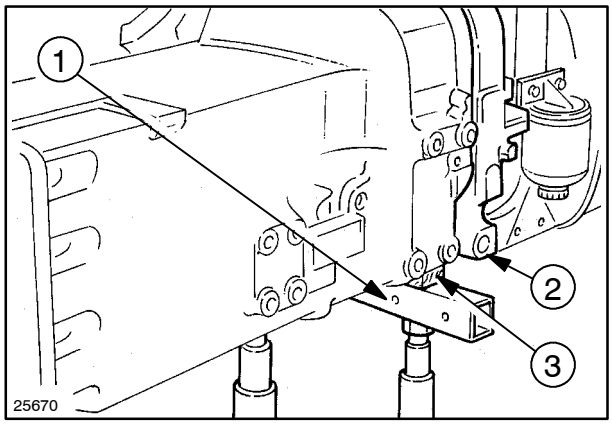
73

68. Position one mobile stand (1) of tool **380000236** under the front part of the transmission-gearbox casing and the other mobile stand under the rear part of the casing.



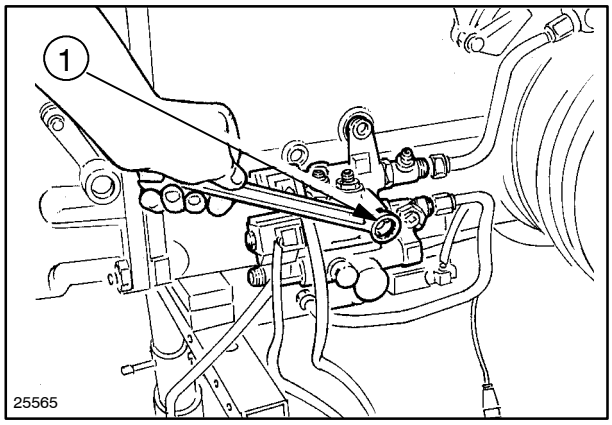
74

69. Position the fixed carriage (1) of tool **380000236** under the clutch casing and insert a wooden block (3) in between. Unscrew the retaining bolts and remove the rear wheels; if necessary, position two fixed stands under the final drives.



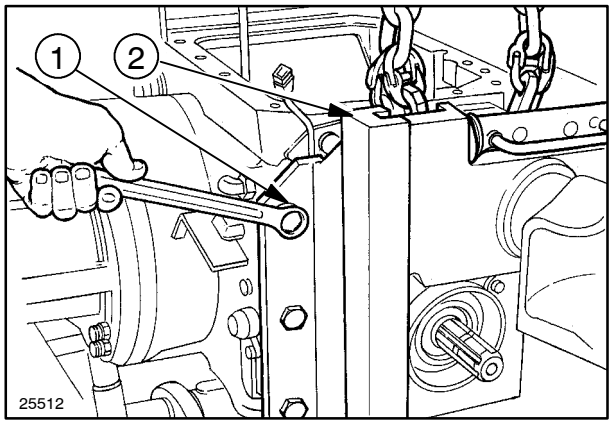
75

70. Take out the bolts (1) securing the services solenoid valve support to the gearbox-transmission casing and remove it.



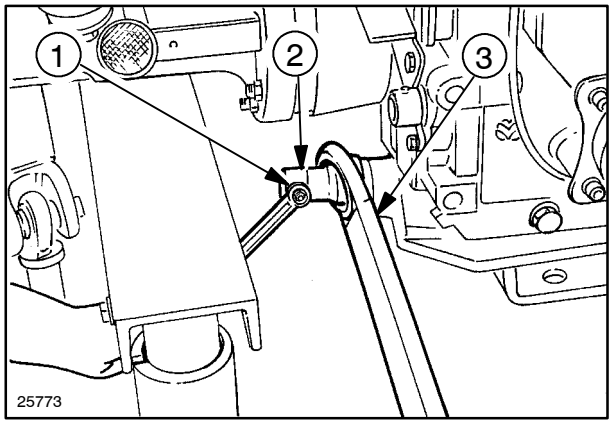
76

71. Using a chain, hitch the towbar to the hoist, unscrew the six retaining bolts (1) and detach the towbar (2).



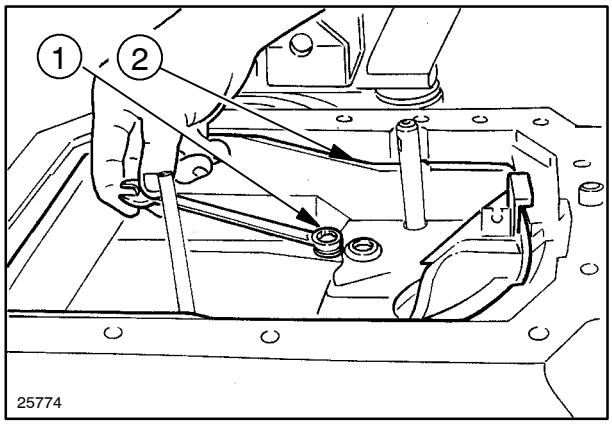
77

72. Unscrew the nut (1), extract the bolt, remove the lower arms (3) and relative spacers (2).



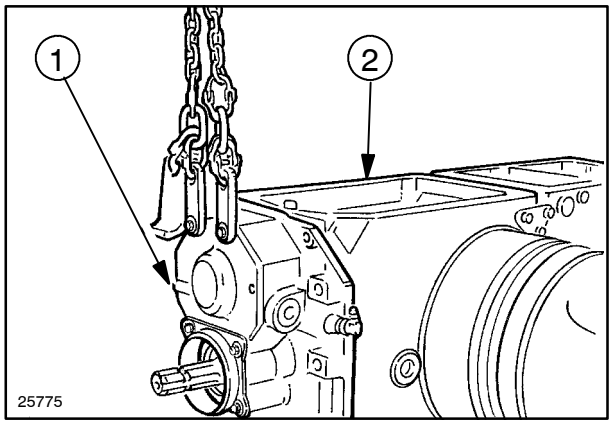
78

73. Take out the bolt (1) and remove the pan (2).



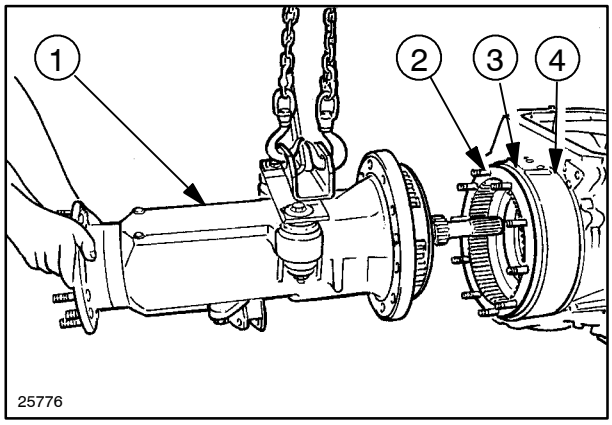
79

74. Using a chain, connect the PTO unit (1) to the hoist, unscrew the retaining bolts and detach the unit from the transmission-gearbox casing (2).



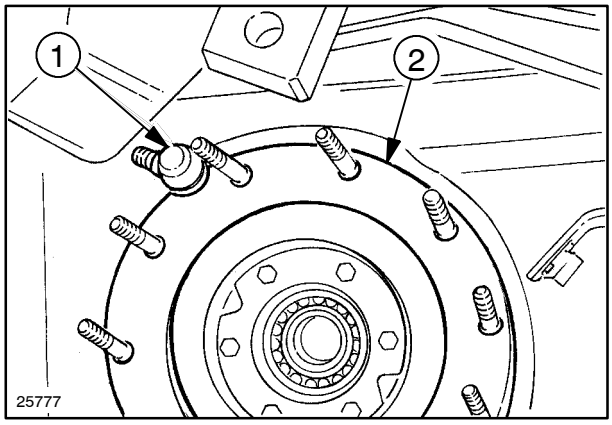
80

75. Using a chain, connect the right-hand final drive unit (1), unscrew the nuts and detach the unit from the transmission-gearbox casing, removing the crown (2) with the brake unit (3) and the friction disk (4).



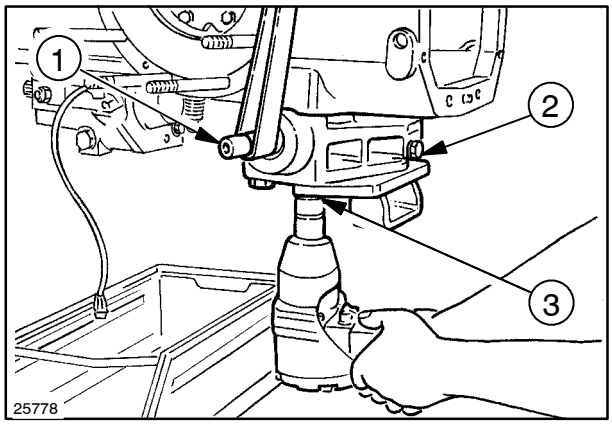
81

76. Detach the left-hand final drive following the description in operation 78.
To detach the friction disk (2), rotate the union on the differential lock (1).



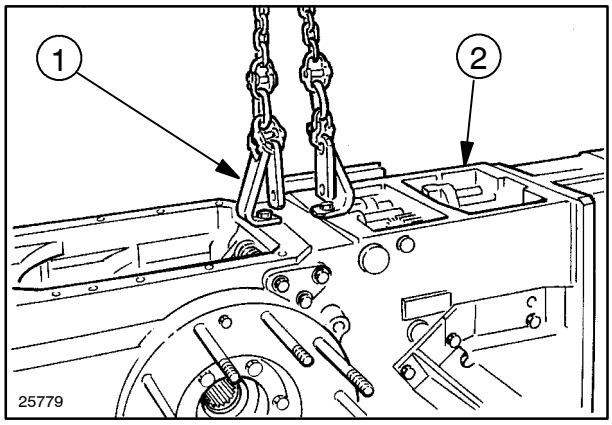
82

77. Remove the plug (2) and drain the oil from the flex bar support.
Using a nylon sling, connect the end of the flex bar (1), to the hoist, unscrew the retaining bolts and remove the unit together with the internal drive rod.



83

78. Hitch the chain (1) to the transmission-gearbox casing (2), connect to a hoist and take up the slack.
Unscrew the retaining bolts and detach the transmission-gearbox casing from the clutch casing using stand **380000236**.



84

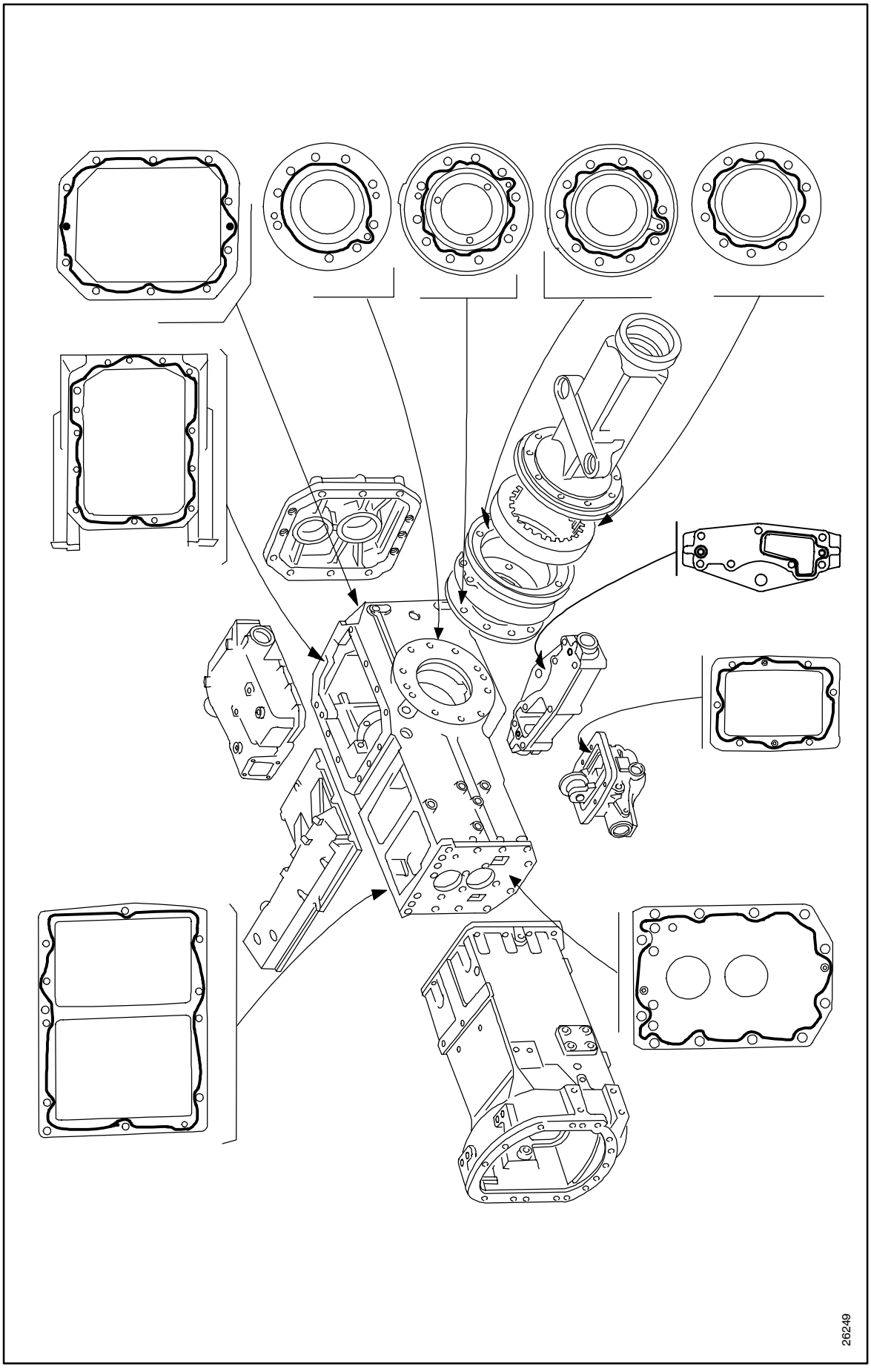
79. To refit the rear transmission-gearbox casing, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- For the correct orientation of the various parts, refer to the illustrations in figs. 10, 11, 12, 13 and 14.
- Before refitting the casings, supports and covers clean and de-grease the mating surfaces and apply sealing compound (approx. 0.0787 in. (2 mm) in diameter) as shown in figure 85.
- Respect the tightening torques prescribed on page 3.
- Using stand **380000236**, refit the rear transmission-gearbox casing to the clutch casing.
- Fit the flex bar and internal drive rod.
- Position the left-hand brake friction disk and secure with the differential lock control union. Assemble the brake unit, crown and final drive unit.
- Assemble the left-hand brake friction disk, the brake unit, crown and final drive unit.
- Refit the PTO to the rear transmission-gearbox casing.
- Assemble the internal tank with relative oil drainage pipe.
- Assemble the lower arms and relative spacers.
- Assemble the towbar.
- Assemble the solenoid valves support, connect all the piping between the valves and the various services.
- Connect the solenoid valve exclusion lever with PTO synchronised with engaged gearbox, adjusting as described in Section 31.
- Connect the electrical connections to the relative solenoid valves and gauges.
- Connect the PTO control and lubrication lines and relative brake.
- Assemble the fuel tank together with the relative retaining brackets.
- Connect the fuel tank connections and lines.
- Refit the hydraulic lift and control valve.
- Connect the service brakes control piping.
- Assemble the trailer brake valve and auxiliary control valves.
- Insert the springs, poppet balls and assemble the gear control rod support cover and final drive on the rear transmission-gearbox casing.
- Assemble and connect the lift control and oil filler piping.
- Assemble the 3-point linkage device support together with the quick-fit coupler and power socket support plate.
- Assemble and connect the auxiliary control valves and trailer brake valve lines.
- Fit the power sockets and ground to the plate-support and connect the relative connections.
- Connect the PTO revs counter connection.
- Assemble and connect all intake and delivery piping on the hydraulic pump, auxiliary control valves, hydraulic lift, movement points, etc.
- Assemble the rear wheels and remove the stand **380000236**.
- Assemble the propeller shaft, securing with the central support and the front and rear sleeves.
- Position and secure the drive shaft guard.
- Tighten the rear transmission-gearbox casing oil drainage plugs and the fuel tank drainage plug.

- Position the cab on the transmission and secure with the relative retaining bolts.
- Connect the Lift-O-Matic control cable.
- Connect the differential lock mechanical control tie-rod, if fitted.
- Connect the parking brake control cable.
- Assemble the main gear and creeper levers and, if fitted, connect the Dual Command (2 Speed Power Shift) connections.
- Assemble the reverser lever, if fitted.
- Connect the PTO speed selection cable.
- Connect the control levers on the Creeper and PTO synchronised with gearbox.
- Connect the auxiliary control valves levers.
- Fit the fuel tank and rear transmission-gearbox breather pipes.
- Connect the lift control levers.
- Connect the quick-fit couplers on the air conditioning system, if fitted; if not, re-position the compressor, the condenser, the dehydrator filter and secure in position.
- Assemble and secure the filter-intake manifold or turbocharger connecting line. Connect the electrical connections on the dehydrator filter and gauge on the connecting line.
- Connect the heating piping and secure in position.
- Connect the gear clutch control tie-rod.
- Connect the direction indicators and sidelights connections.
- Connect the steering cylinder control piping.
- Connect the throttle control cable.
- Connect the service brakes piping to the relative pumps and the electrical connections on the tank and pressure gauges.
- Connect the piping on the anticavitation tank.
- Connect and secure the speedometer/tachometer cable.
- Connect the electrical connections between the cab and the tractor body.
- Assemble the engine bonnet support bracket and secure in position.
- Assemble the bonnet and gas springs and secure in position.
- Connect the front lights connections.
- Tighten the coolant drainage plug on the engine block.
- Fill up the fuel tank, the rear transmission-gearbox and the cooling circuit; for recommended products and quantities see Section 00.
- Connect the negative cable to the battery.



85

Sealing compound application diagram for transmission-gear box casing

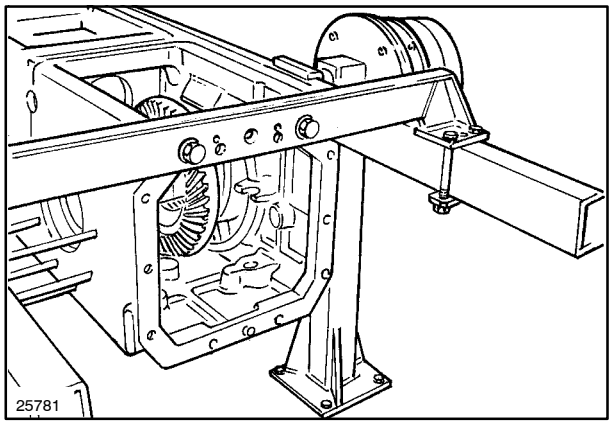
The types of sealing compounds to be applied are specified in Section 00.

Op. 21 118 85
GEARBOX-TRANSMISSION CASING D.A. and adjustments

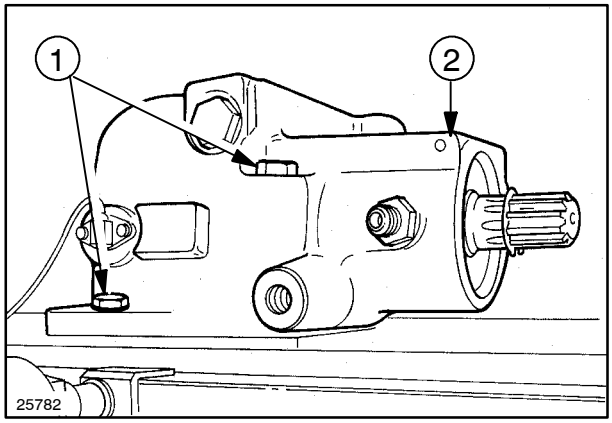
CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Fix the gearbox-transmission casing to the rotating stand **380000301** using front bracket **380000272** and rear bracket **380000271**.
2. Rotate the casing through 180° unscrew the bolts (1) and remove the drive casing (2).

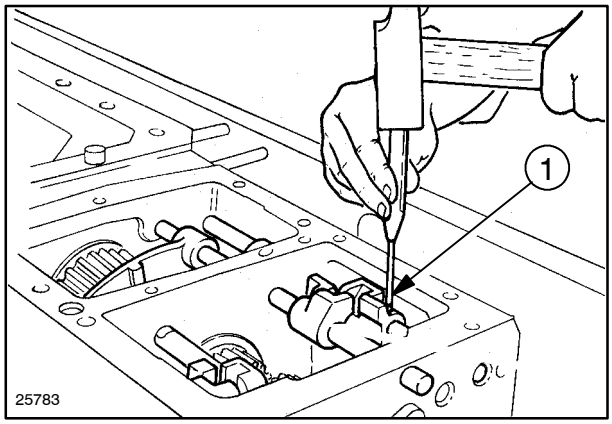


86



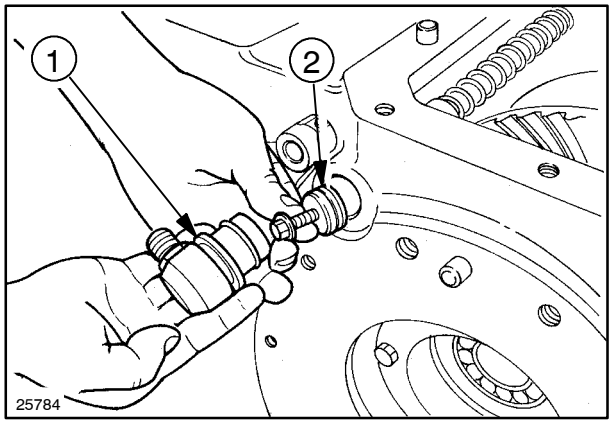
87

3. Rotate the casing through 180° using a punch, extract the pins (1) and remove the rods, teeth and control forks on the gear and range unit.



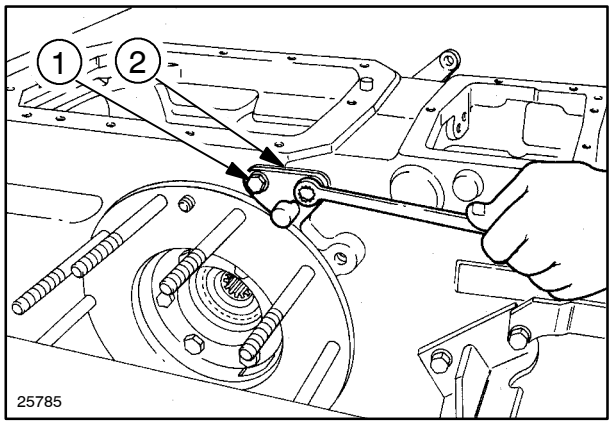
88

4. Extract the oil inlet union (1), tighten one bolt and extract the differential lock control piston.



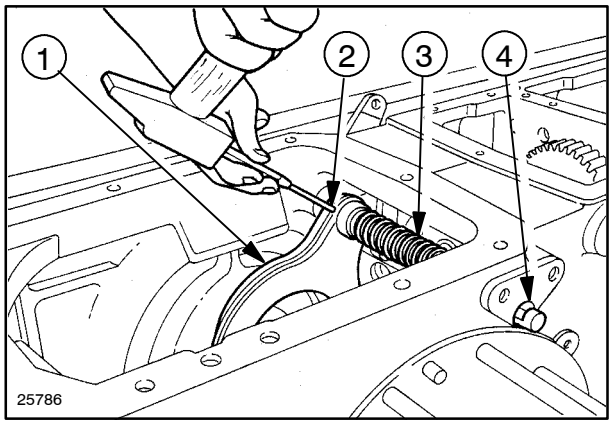
89

5. Unscrew the bolts (1), detach the stop plate (2) and remove the adjusting shims.



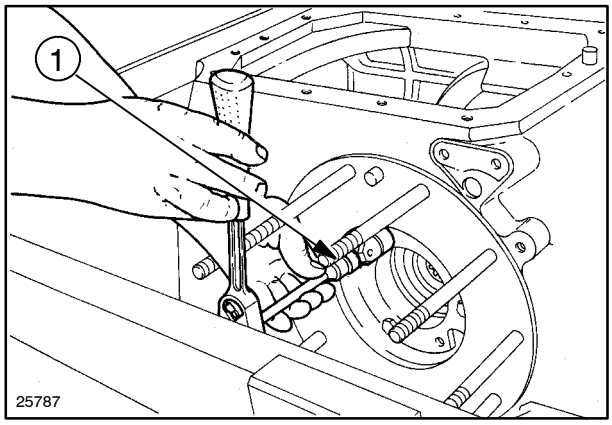
90

6. Using a punch, remove the pin (2) securing the differential lock engagement fork (1), extract the rod (4) and remove the spring (3) and fork.



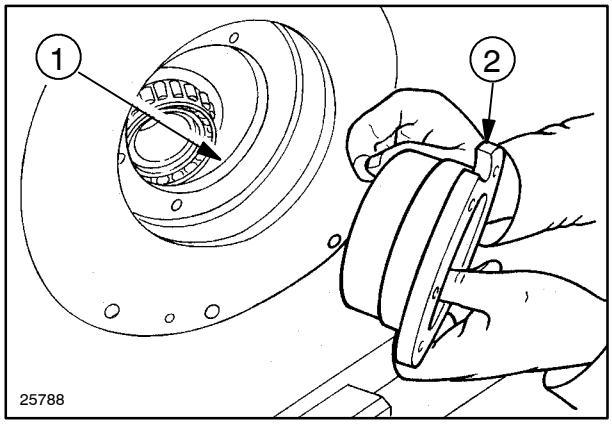
91

7. Take out the bolts (1) securing the differential support (on both sides).



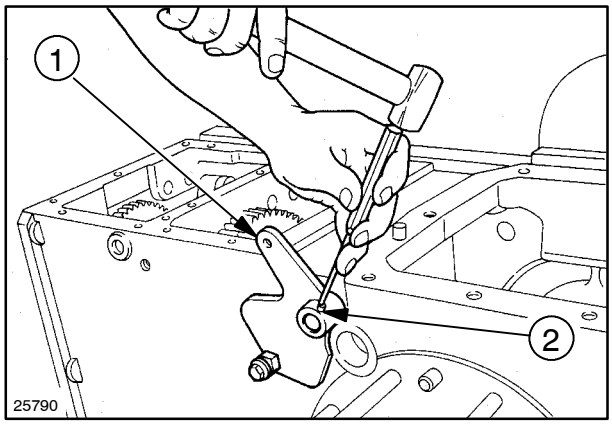
92

8. Remove the differential supports (2) and the adjusting shims (1) (on both sides) and remove the bevel crown wheel, complete with differential, from the transmission casing.



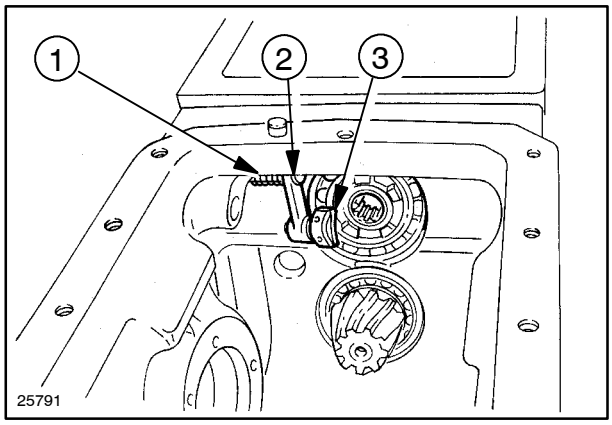
93

9. Extract the pin (2) and detach the external lever (1) for the PTO synchronized with gearbox.



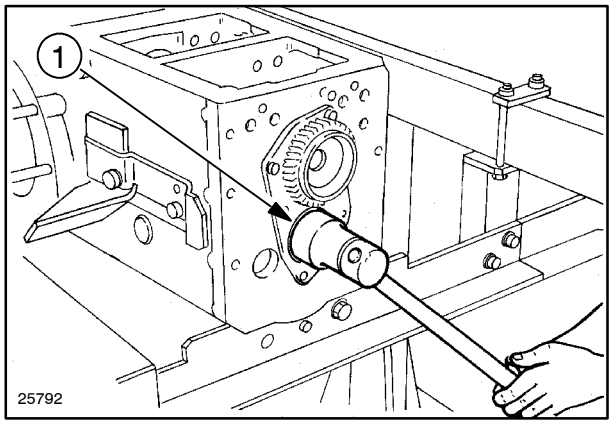
94

10. Extract the internal lever (2), spring (1) and block (3).



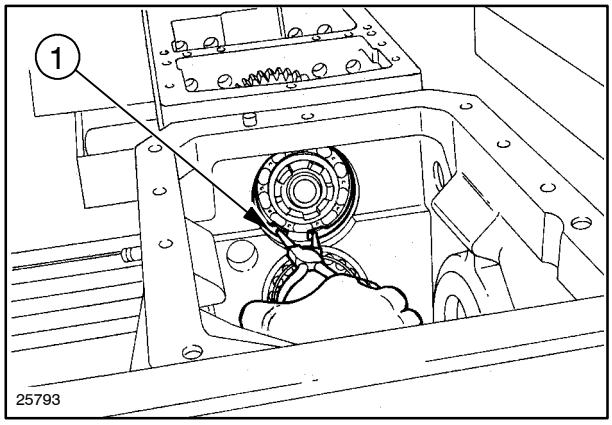
95

11. Release and unscrew the nut (1) securing the driven shaft.



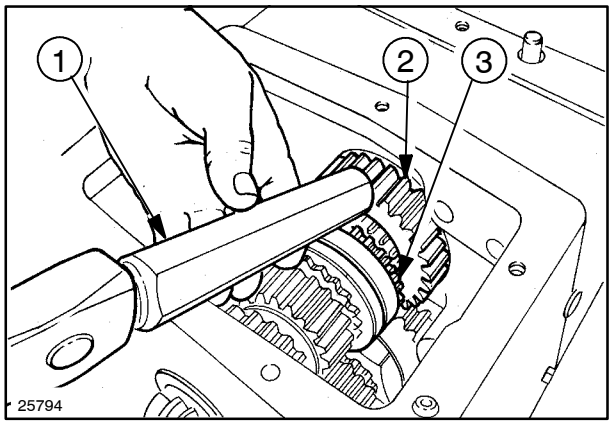
96

12. Remove the circlip (1) retaining the final drive driving shaft bearing from the rear.



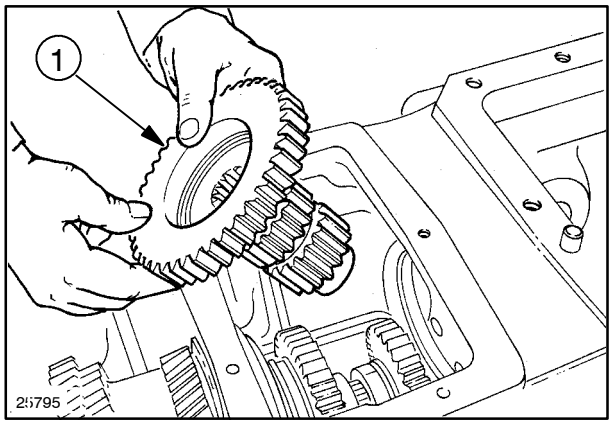
97

13. Using a hammer and a brass punch (1) extract the mid gear unit (2) together with the relative bearing and engagement sleeve (3).



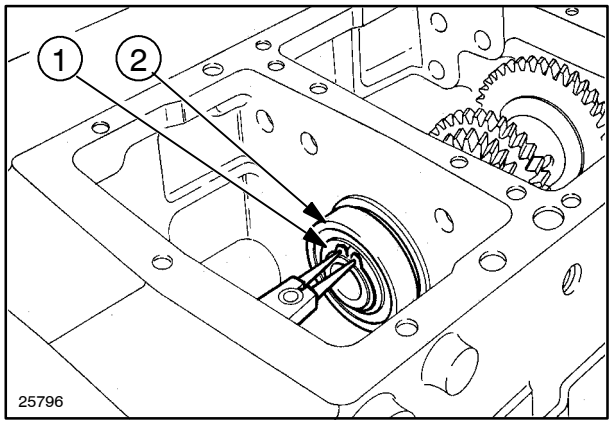
98

14. Extract the final drive driving shaft (1).



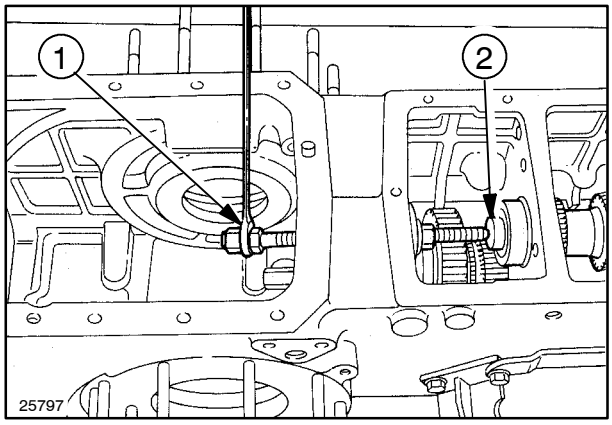
99

15. Remove the circlip (1) retaining the bearing (2) on the gearbox driving shaft.



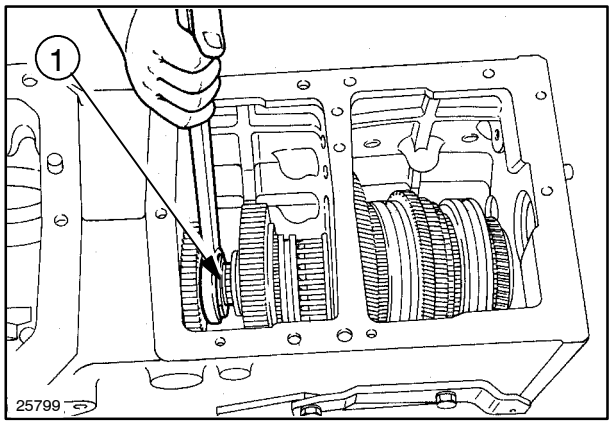
100

16. Fit tool **50006** (2, fig. 5) on the driving shaft and, using the extractor (1), extract the driving shaft, bearings, gears and relative bushings.



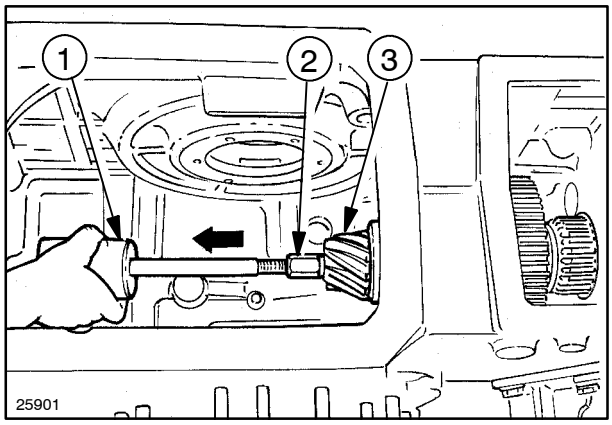
101

17. Release the washer on the nut (1) and loosen the nut.



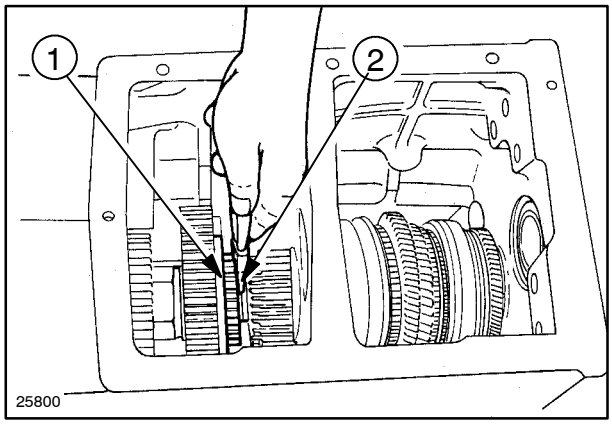
102

18. On the pinion (3), tighten the adapter **50144** (2, Fig. 8) and, using the extractor (1), move the bevel pinion, in the direction indicated, by a few millimeters.



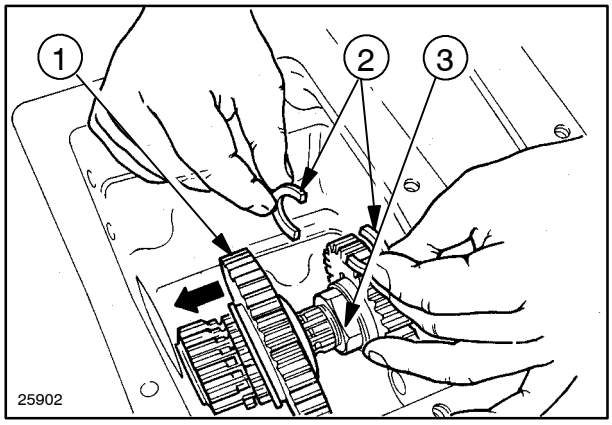
103

19. Move the engagement sleeve (1) until pliers (2) can be inserted to remove the circlip.



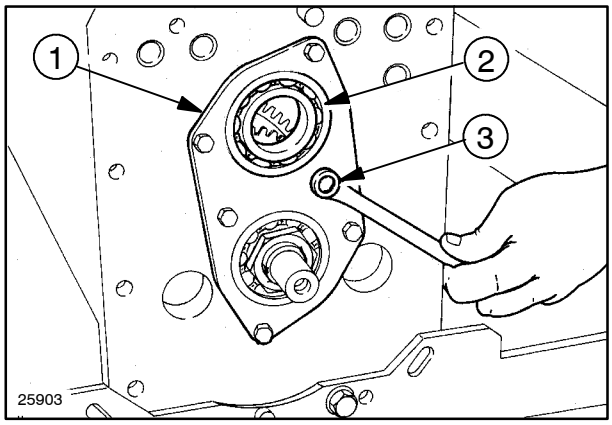
104

20. Move the gear unit (1) in the direction indicated by the arrow and remove the two split rings (2), unscrew the nut (3) and extract the bevel pinion and all parts.



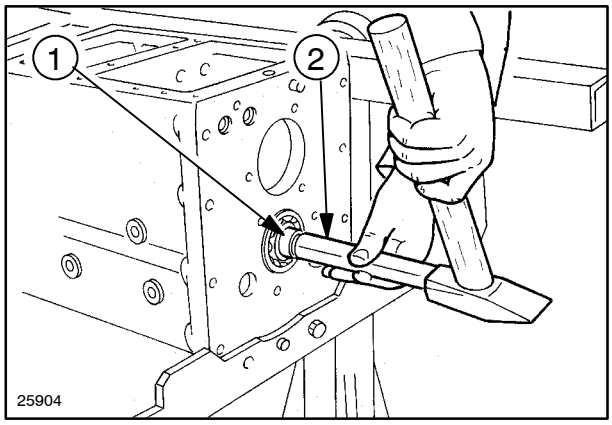
105

21. Unscrew the bolts (3), disassemble the support plate (1) and remove the bearing (2).



106

22. Using a brass punch (2) and hammer, extract the driven shaft (1) and remove all parts.
23. To assemble the rear transmission-gearbox casing, proceed as follows.
24. For the correct orientation of the various parts, refer to the illustrations in figs. 10, 11, 12, 13 and 14.
25. Respect the tightening torques prescribed on page 3.

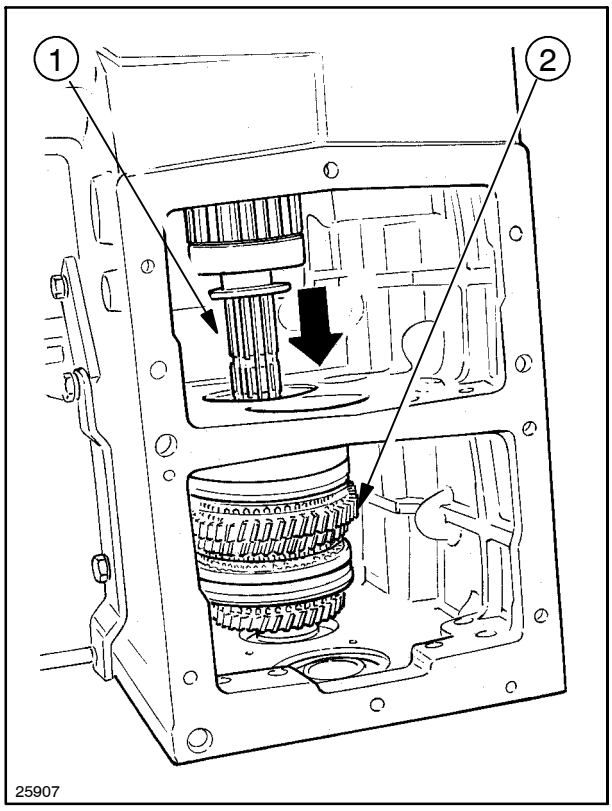


107

CAUTION

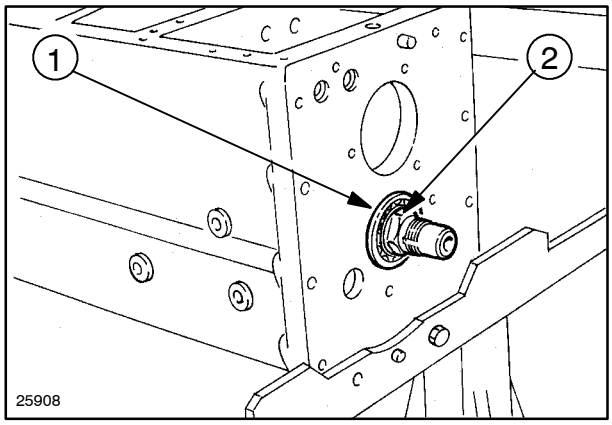
Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

26. Position the casing vertically, insert the gearbox driven shaft gear assembly (2) and fit the shaft (1).



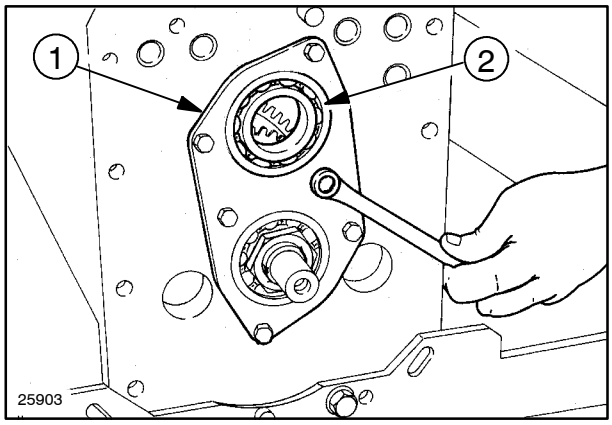
108

27. Rotate the casing through 90°, assemble the front bearing (1) and nut (2), tightening to the prescribed torque value.



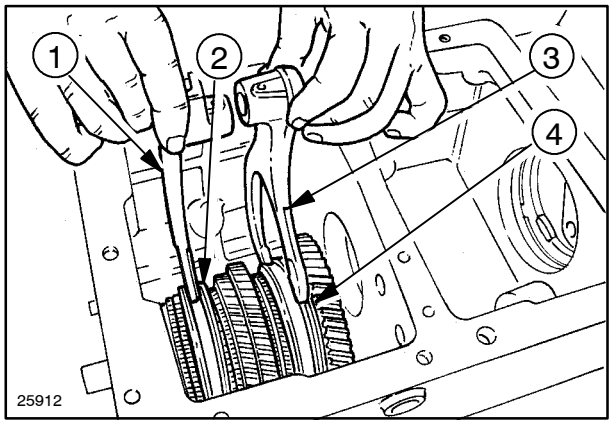
109

28. Fit the bearing (2) in its seat on the casing (front side) and lock it with the plate (1).



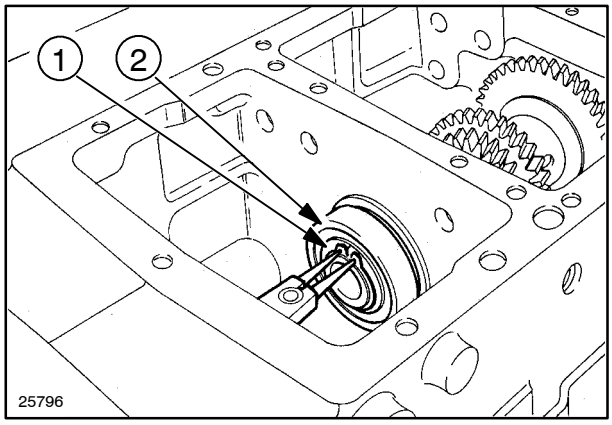
110

29. Insert the gear forks (1 and 3) on the synchroniser sliding rings (2 and 4).
30. Assemble the bevel pinion with all parts and carry out the adjustments described on page 49.



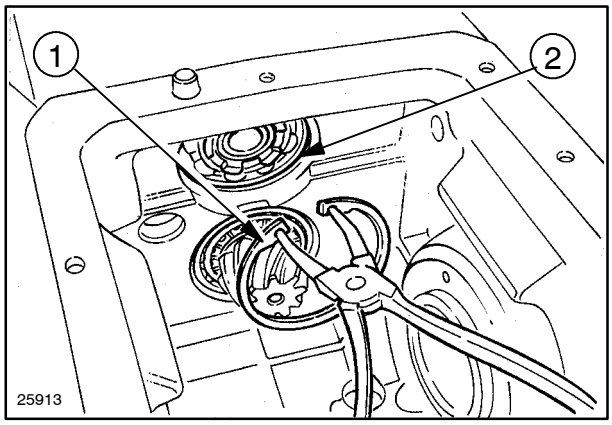
111

31. Assemble the gearbox driving shaft, with all parts, and the adjusting shim (3, page 8), then position the bearing (2) and secure with the circlip (1).



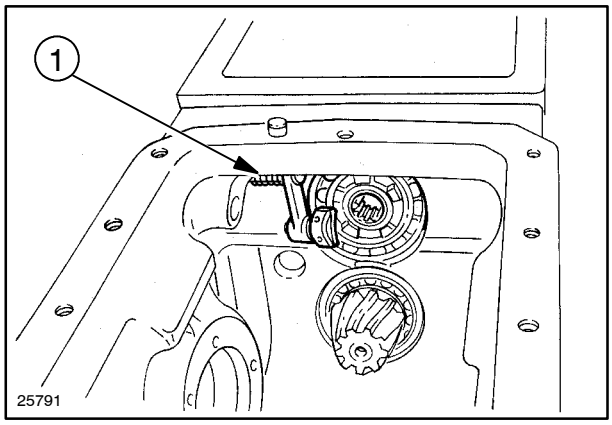
112

32. Insert the final drive driving shaft, from the rear, fit the bearing (2) in the seat and secure with the circlip (1).



113

33. Fit the lever (1) governing the p.t.o. synchronized with the gearbox comprehensive of spring, pawl and external lever.
34. Fit the bevel crown wheel assembly (see adjustments on page 52).
35. Assemble the differential lock engagement fork and spring rod, external plate and relative adjusting shims (see page 48).
36. Assemble the piston and differential lock control union.
37. Assemble all the gearbox and range control rods, forks and teeth.
38. Assemble the drive unit.



114

GEARBOX TRANSMISSION CASING
Gearbox driving shaft end float adjustment

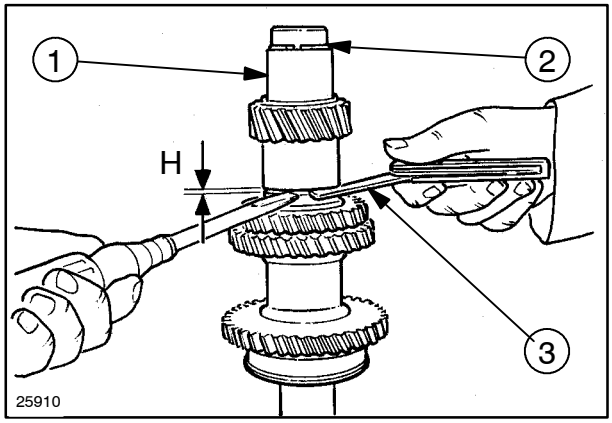
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

Proceed as follows.

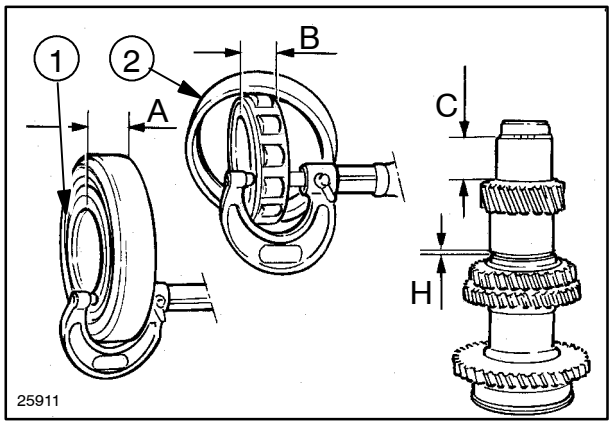
NOTE: *When fitted, the driving shaft gears must have an end float of 0 to 0.0098 in. (0 to 0.25 mm). The bearings must therefore be adjusted to prevent them from being mounted with an axial preload.*
In order to carry out this adjustment, construct tool 5007 in a workshop, as shown in fig. 6.

39. Assemble all driving shaft components on the workbench, replacing the two rear bearings and the adjusting ring with tool **50007** (1).
40. Insert a screwdriver between the gear and the relative bushing and measure the clearance (H) with a feeler gauge.



115

41. Measure the height (C) of the tool **50007** and the thickness of the two rear bearings (1 and 2).
42. The required adjusting thickness will be given by:
    S = H + C - A - B
    where:
    H = measured clearance
    A and **B** = bearings **measured** thickness
    C = height of the tool.
    Example:
- measured clearance H = 0.0511 in. (1.3 mm)
- height of tool = 0.7125 in. (43.5 mm)
- thickness of ball bearing (1) = 0.9015 in. (22.9 mm)
- thickness of roller bearing (2) = 0.7086 in. (18 mm)
- adjusting shim thickness:
  S = 0.0511 + 0.7125 - 0.9015 - 0.7086 = 0.1535 in.
  (1.3 + 43.5 - 22.9 - 18 = 3.9 mm)



116

NOTE: *As the gears must be assembled with an axial clearance of 0 to 0.0098 in. (0 to 0.25 mm), a 0.1476 in. (3.75 mm) shim (S) must be assembled, providing an end float of: 0.1535 - 0.1476 = 0.0059 in. (3.9 - 3.75 = 0.15 mm).*

GEARBOX TRANSMISSION CASING

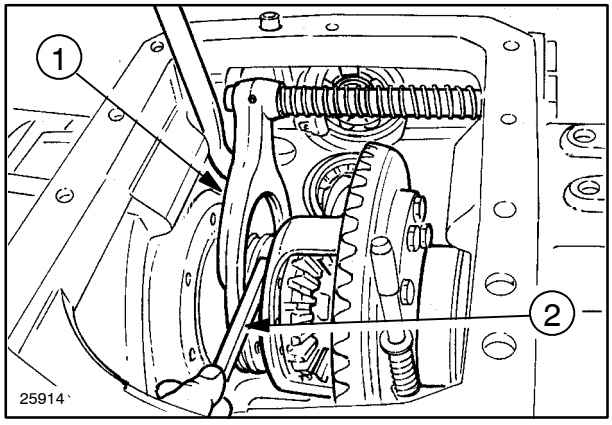
Adjusting the position of differential lock engagement sleeve

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

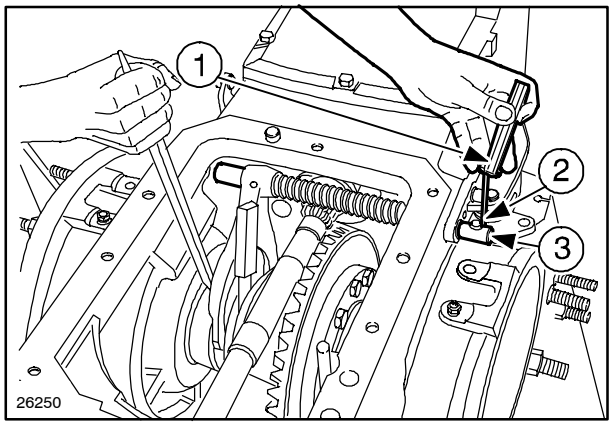
Proceed as follows.

43. Assemble the differential lock release device (mechanically operated model) or the plate (version with hydraulic control) without the adjusting shim.
44. Insert gauge **50041** (2, fig. 2) with the 0.3188 to 0.3228 in. (8.1 to 8.2 mm) shim between the sleeve and the differential casing, so that it makes contact with the sliding surfaces of the sleeve on the casing.
45. Using a crowbar, bring the sleeve into contact with gauge **50041** and the differential casing, adjusting the fork (1) to the position of the gauge.



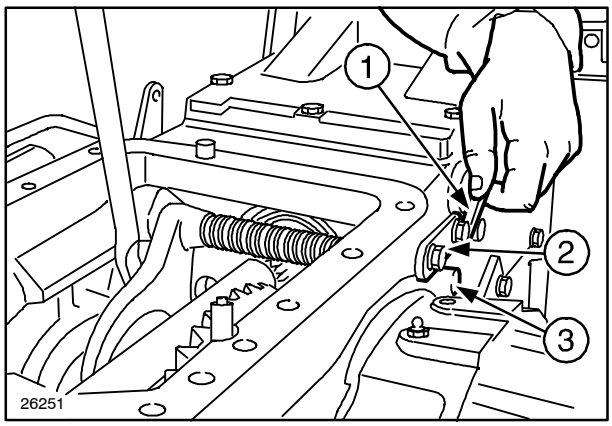
117

46. Using a feeler gauge (1), measure the clearance between the control pin (2) and the seat on the rod (3) (mechanically operated model).



118

47. Using a feeler gauge (1), measure the clearance between the plate (2) and the seat on the rod (3) (hydraulically operated model).
48. Position the required shim under the differential lock release control device (mechanically operated model) or under the plate (2) (hydraulically operated model) and secure in position using the bolts.



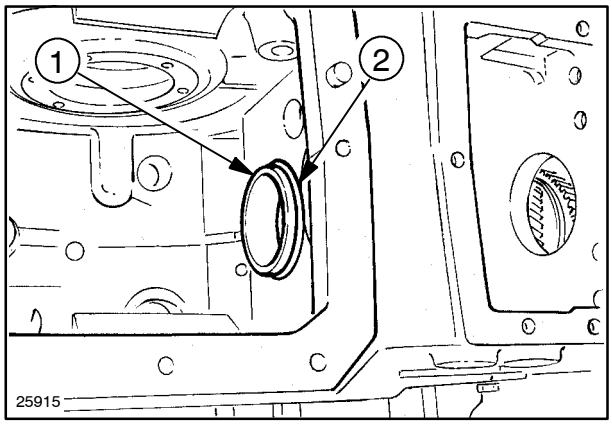
119

BEVEL DRIVE ADJUSTMENTS

Determining the thickness of the bevel pinion position adjustment shim (8, fig. 10)

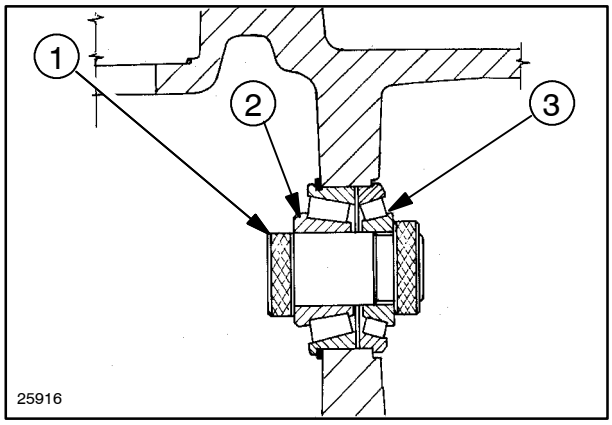
Proceed as follows:

49. Assemble the bearing external ring (1) on the gearbox-transmission casing with the test shim (2) and the bearing external ring (3, fig. 121).



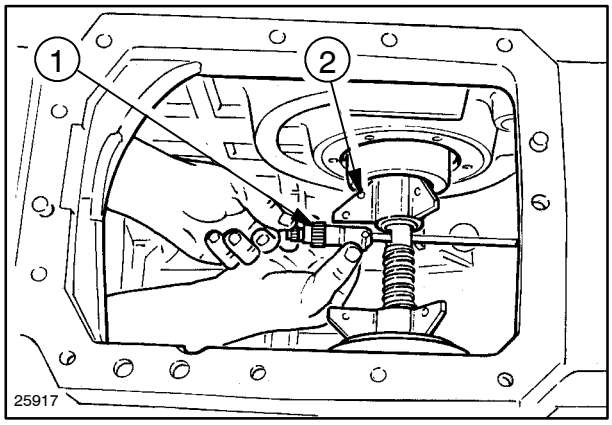
120

50. Position the bearing (2) on tool **50004** (1, see fig. 4), insert the bearing (3) and lock the tool (1).



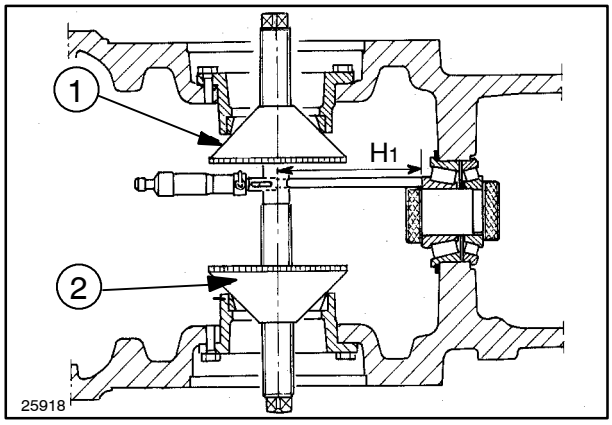
121

51. Position tool **380000249** (2) with the conical parts in the bevel crown wheel supports and insert the micrometer (1) with the depth rod in the seat, securing in position with the bolt.



122

52. Screw the two cones (1 and 2) in or out in order to position the micrometer in correspondence with the bearing, adjust the cones (1 and 2) by hand to lock the tool on the support and eliminate any end float.
53. Move the rod so that it makes contact with the bearing and note the reading (H_1).



123

54. Determine the correct distance (H_3) between the crown wheel axis and the large diameter base of the pinion:

$$H_3 = H_2 + C$$

where:

H_2 = 5.7283 in. (145.5 mm). Nominal distance between crown wheel axis and greater diameter of the pinion.

C = correction value stamped on pinion, in mm and preceded by a + or - sign (if other than 0), to be added to or subtracted from the nominal distance (H_2) according to the sign.

55. The thickness of the adjustment shim (S) will be given by:

$$S = H_1 + Sp - H_3$$

where:

H_1 = micrometer reading.

H_3 = corrected nominal distance between the crown wheel axis and the greater diameter base of the pinion.

Sp = Test ring.

Example

Distance measured using micrometer H_1 = 5.7440 in. (145.9 mm).

Test ring thickness Sp = 0.0748 in. (1.90 mm).

Nominal distance between crown wheel axis and large diameter base of H_2 = 5.7283 in. (145.5 mm).

Correction value C = + 0.0078 in. (+ 0.2 mm).

Corrected nominal distance
H_3 = 5.7283 + 0.0078 = 5.7362 in.
(145.5 + 0.2 = 145.7 mm).

Thickness of the adjustment ring:
S = 5.7440 + 0.0748 - 5.7362 = 0.0826 in.
(145.9 + 1.90 - 145.7 = 2.10 mm).

Correction value C = - 0.0078 in. (- 0.2 mm).

Corrected nominal distance
H_3 = 5.7283 - 0.0078 = 5.7204 in.
(145.5 - 0.2 = 145.3 mm).

Thickness of adjustment shim:

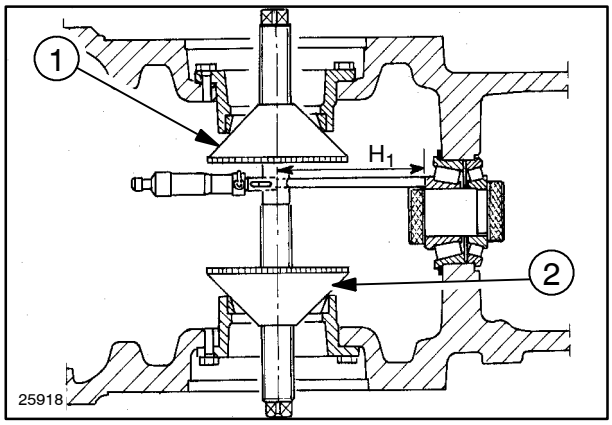
S = 5.7440 + 0.0748 - 5.7204 + 0.0984 in.
(145.9 + 1.90 - 145.3 = 2.50 mm).

Correction value C = 0 mm.

Corrected nominal distance
H_3 = H_2 = 5.7283 in. (145.5 mm).

Thickness of the adjustment ring:
S = 5.7440 + 0.0748 - 5.7283 = 0.0905 in.
(145.9 + 1.90 - 145.5 = 2.30 mm).

56. Disassemble tools **380000249** and **50004**; remove the external rings on the bearings, the test shim and the two differential supports.



124

ADJUSTING THE BEVEL DRIVE

Tapered roller bearings adjustment for pinion shaft

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

CAUTION

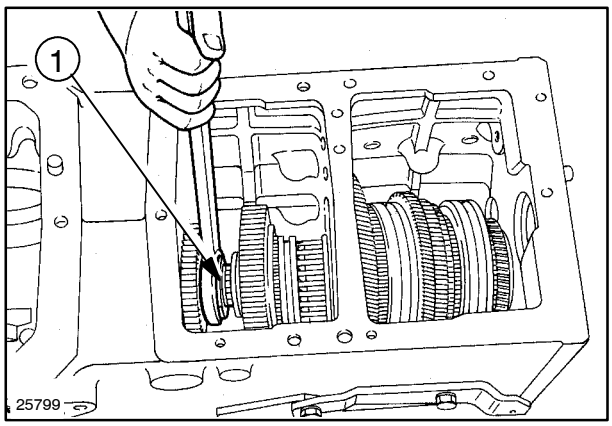
Always use appropriate tools to align fixing holes. NEVER USE YOUR FINGERS OR HANDS.

Proceed as follows:

57. Assemble the bearing external race with the previously determined shim ring.

58. Assemble the bevel pinion and relative parts.

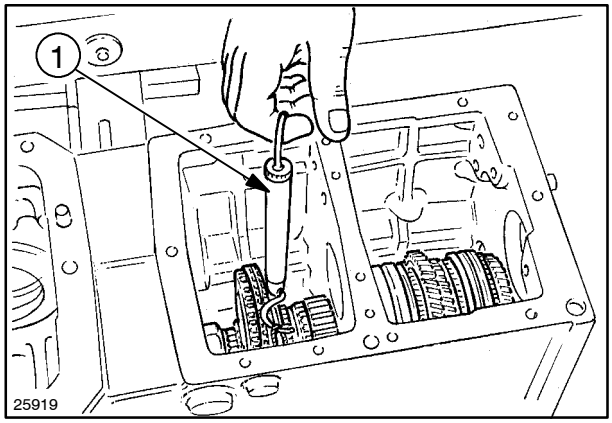
59. Tighten the adjusting nut (1), while simultaneously rotating the pinion shaft to ensure that the bearings are seated correctly, to a rolling torque of 0.75 to 1.5 Nm (0.075 to 0.150 kgm). **Take the reading with a torque wrench and cable wound round the low gear unit located on the pinion,** making sure that the gear shaft is not dragged.



125

60. The rolling torque corresponds to the force read with the torque wrench (1) of 8.6 to 17.2 N (0.88 to 1.75 kg).

NOTE: *The pinion rolling torque can be read directly on the bevel crown wheel (not pre-loaded) using the values shown on page 54.*



126

ADJUSTING THE BEVEL DRIVE

Adjusting the bevel crown wheel bearings and checking the clearance between the sides of the bevel drive teeth

CAUTION

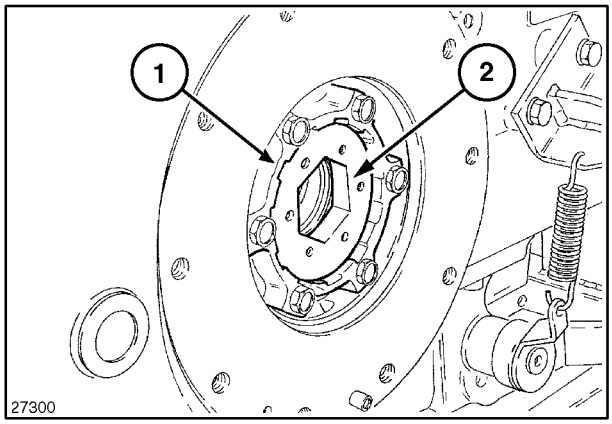
Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

CAUTION

Always use appropriate tools to align fixing holes.
NEVER USE FINGERS OR HANDS.

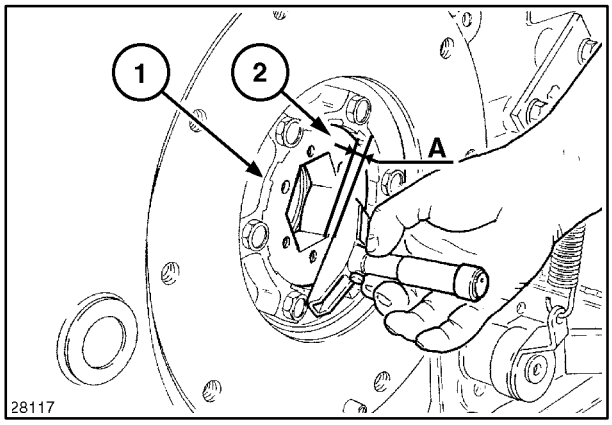
Proceed as follows.

61. With the bevel pinion fitted, insert the differential assembly complete with the bevel crown wheel. Fit the right-hand support (1) on the gearbox-transmission casing and position the ring nut (2) flush to the support.



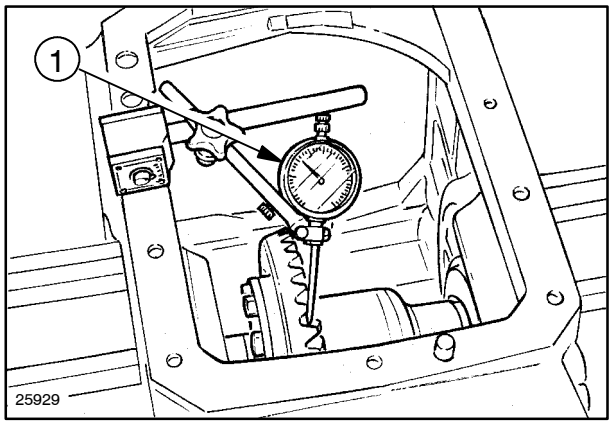
127

62. Assemble the left-hand support and tighten, using wrench **50027** (see fig. 9), the ring nut to a torque of 49 Nm (5 kgm) to settle in the bearings.
63. Unscrew the left-hand ring nut until it is flush with the relative support.
64. Tighten the right-hand ring nut (2) to obtain a distance of A = 0.2529 in (6.5 mm) between the external surface of the support (1) and the external surface of the ring nut.



128

65. Bring the left-hand ring nut into contact with the relative bearing and tighten to a torque of 9.8 Nm (1 kgm) to adjust the clearance.
66. Using a 1/100 dial gauge (1), measure the radial clearance on the sides of the bevel drive teeth, under these conditions the clearance is 0.0157 to 0.0236 in. (0.4 to 0.6 mm) (three measurements at 120° and arithmetic mean of the three readings).
67. Loosen the left-hand ring nut by one turn.
68. Tighten the right-hand ring nut to obtain the correct clearance, according to the following table for radial clearance/axial movement.

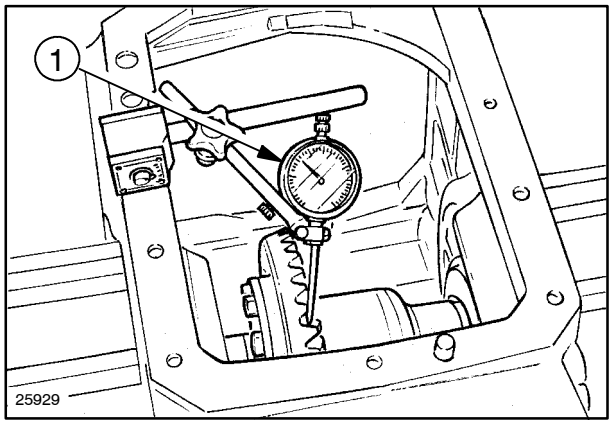


129

9/43 bevel drive		11/43 bevel drive	
Clearance between the teeth in. (mm)	Axial movement in. (mm)	Clearance between the teeth in. (mm)	Axial movement in. (mm)
0.0019 (0.05)	0.0027 (0.07)	0.0019 (0.05)	0.0027 (0.07)
0.0039 (0.10)	0.0051 (0.13)	0.0039 (0.10)	0.0051 (0.13)
0.0059 (0.15)	0.0078 (0.20)	0.0059 (0.15)	0.0078 (0.20)
0.0078 (0.20)	0.0106 (0.27)	0.0078 (0.20)	0.0106 (0.27)
0.0098 (0.25)	0.0129 (0.33)	0.0098 (0.25)	0.0133 (0.34)
0.0118 (0.30)	0.0157 (0.40)	0.0118 (0.30)	0.0157 (0.40)
0.0137 (0.35)	0.0185 (0.47)	0.0137 (0.35)	0.0185 (0.47)
0.0157 (0.40)	0.0208 (0.53)	0.0157 (0.40)	0.0212 (0.54)
0.0177 (0.45)	0.0236 (0.60)	0.0177 (0.45)	0.0240 (0.61)
0.0196 (0.50)	0.0263 (0.67)	0.0196 (0.50)	0.0263 (0.67)
0.0216 (0.55)	0.0287 (0.73)	0.0216 (0.55)	0.0291 (0.74)
0.0236 (0.60)	0.0314 (0.80)	0.0236 (0.60)	0.0318 (0.81)
0.0255 (0.65)	0.0342 (0.87)	0.0255 (0.65)	0.0346 (0.88)
0.0275 (0.70)	0.0366 (0.93)	0.0275 (0.70)	0.0370 (0.94)
0.0295 (0.75)	0.0393 (1.00)	0.0295 (0.75)	0.0397 (1.01)
0.0314 (0.80)	0.0421 (1.07)	0.0314 (0.80)	0.0425 (1.08)
0.0728 (0.85)	0.0444 (1.13)	0.0728 (0.85)	0.0452 (1.15)

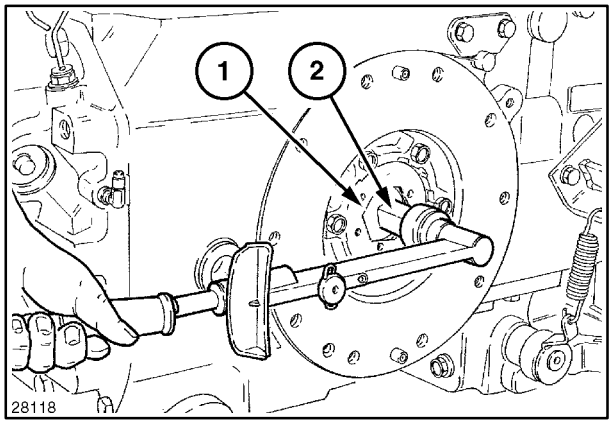
69. Bring the left-hand ring nut into contact with the relative bearing and tighten to a torque of 9.8 Nm (1 kgm) to adjust the clearance.

70. Using a 1/100 dial gauge (1), measure the radial clearance on the sides of the bevel drive teeth, (three measurements at 120° and arithmetic mean of the three readings) and compare the mean of the three values with the normal clearance: 0.0070 to 0.0090 in. (0.18 to 0.23 mm), on average 0.0082 in. (0.21 mm) [the difference between the three measurements must not exceed 0.0019 in. (0.05 mm)].



130

71. Using wrench **50027** (2), tighten the right-hand ring nut (1) by a further 0.0039 in. (0.10 mm) to preload the bevel drive bearings.

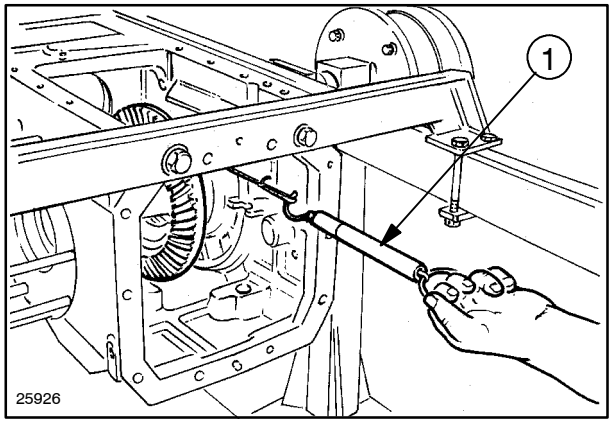


131

72. Check the rolling torque on the bevel crown wheel according to the values shown on the table below, and make sure that the gear shafts are not dragged during this operation.

	9/43 bevel drive	11/43 bevel drive	9/43 bevel drive	11/43 bevel drive
Pinion rolling torque	Pinion rolling torque on crown wheel		Total pinion and crown wheel rolling torque on crown wheel	
kgm	kgm	kgm	kgm	
0,075 to 0,150	0,360 to 0,720	0,290 to 0,590	pinion torque + (0.100 to 0.200)	

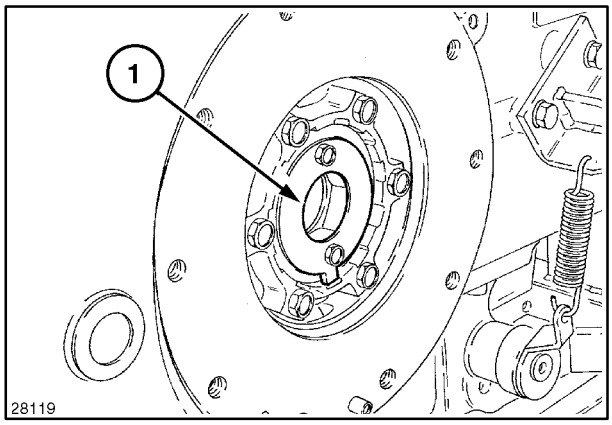
73. The rolling torque can be checked using torque wrench (1), according to the values shown on the table below.



132

Differential casing ∅ 5.7480 in. (146 mm) (model TL70)				
	9/43 bevel drive	11/43 bevel drive	9/43 bevel drive	11/43 bevel drive
Pinion rolling torque	Torque wrench force, of pinion, on crown wheel		Torque wrench force, of pinion and crown wheel, on crown wheel	
kgm	kg	kg	kg	
0,075 to 0,150	4,93 to 9,86	3,97 to 8,08	Force on pinion + (1.37 to 2.73)	
Differential casing ∅ 6.2992 in. (160 mm) (models TL80 and TL90)				
	9/43 bevel drive	11/43 bevel drive	9/43 bevel drive	11/43 bevel drive
Pinion rolling torque	Torque wrench force, of pinion, on crown wheel		Torque wrench force, of pinion and crown wheel, on crown wheel	
kgm	kg	kg	kg	
0,075 to 0,150	4,50 to 9,00	3,63 to 7,38	Force on pinion + (1.25 to 2.50)	
Differential casing ∅ 7.4015 in. (188 mm) (model TL100 and (as an optional) model TL90)				
	9/43 bevel drive	11/43 bevel drive	9/43 bevel drive	11/43 bevel drive
Pinion rolling torque	Torque wrench force, of pinion, on crown wheel		Torque wrench force, of pinion and crown wheel, on crown wheel	
kgm	kg	kg	kg	
0,075 to 0,150	3,83 to 7,66	3,09 to 6,28	Force on pinion + (1.06 to 2.13)	

74. Lock the right and left-hand ring nuts in position with the lock ring (1).



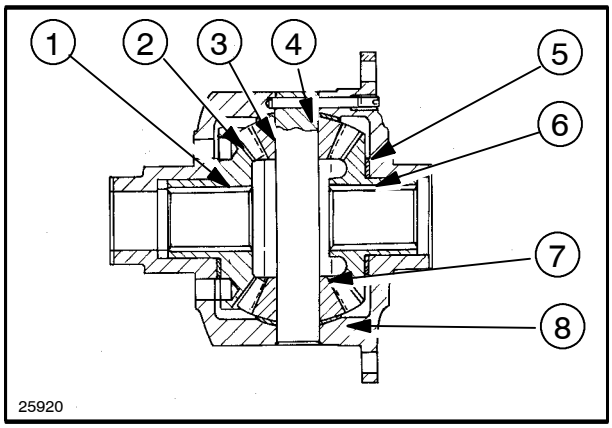
133

ADJUSTING THE BEVEL DRIVE

Adjustment of the clearance between the sun and planet pinion teeth

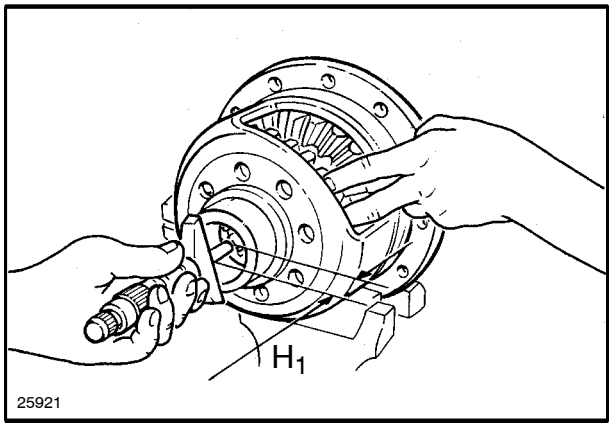
With the differential disassembled on the bench, proceed as follows.

75. Fit the two sun gears (2 and 5) without rings (1 and 6) on the differential casing. Insert the planet gears (3 and 8) complete with fifth wheel ring adjustment and pin (7); turn the retaining bolt (4) a few times to prevent the pin from sliding out.



134

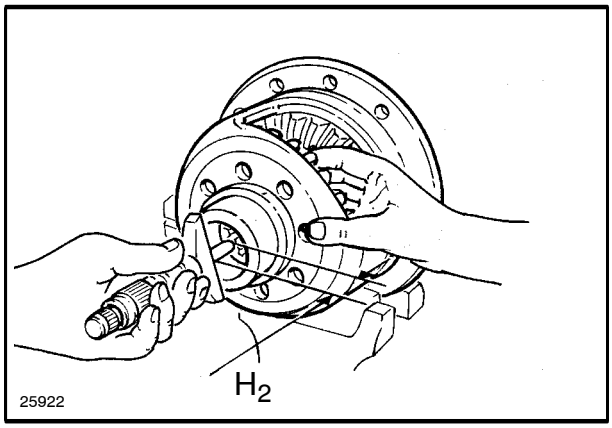
76. Manipulate the LH sun gear so that it comes into contact with the planet gear and, using a depth micrometer, measure the distance (H_1), taking two diametrically opposed measurements, taking the arithmetic means of the two values measured.



135

77. Push the sun gear so that it touches the differential casing and measure the distance (H_2).

78. Repeat the same operations for the RH sun gear.



136

79. The axial movement of the sun gears (2 and 5) without adjustment shims is given by:

$$\mathbf{Gs} \text{ or } \mathbf{Gd} = \mathbf{H_1 - H_2}$$

where:

Gs = axial movement of LH sun gear;

Gd = axial movement of RH sun gear;

$\mathbf{H_1}$ and $\mathbf{H_2}$ = are the LH or RH sun gear measurements.

The normal clearance envisaged between the sides of the sun and planet gear teeth is 0.0059 in. (0.15 mm) for models TL70, 0.0070 in. (0.18 mm) for models TL80, TL90 and TL100.

Therefore, the normal clearance and the equivalent axial movement of the sun gears has an average ratio of **1:1.7**.

The axial movement of the sun gears corresponding to the normal clearance is:

0.15 x 1.7 = **0.0098 in. (0.25 mm)** for models TL70.

0.18 x 1.7 = **0.0118 in. (0.30 mm)** for models TL80, TL90 and TL100.

Therefore the adjustment rings (1 and 6) to insert on the differential housing will be given by:

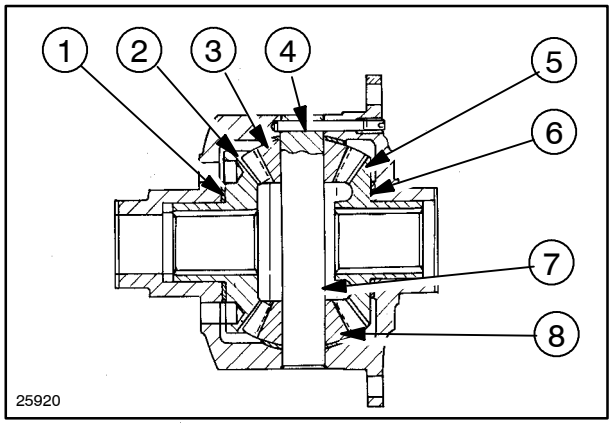
Ss = **Gs - 0.0098 in. (0.25 mm)**
(for LH sun gear models TL70)

Sd = **Gd - 0.0098 in. (0.25 mm)**
(for RH sun gear models TL70)

Ss = **Gs - 0.0118 in. (0.30 mm)**
(for LH sun gear models TL80, TL90 and TL100).

Sd = **Gd - 0.0118 in. (0.30 mm)**
(for RH sun gear models TL80, TL90 and TL100).

Insert the adjustment rings closest to the value obtained (the available values are listed on page 2).

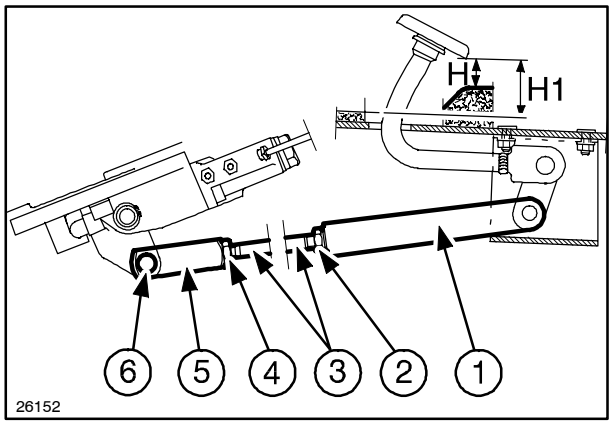


137

Op. 27 110 10
ADJUSTMENT OF THE DIFFERENTIAL LOCK CONTROL PEDAL STROKE

For models fitted with the platform and safety bar, the distance (H_1) between the base of the control pedal and the top of the trim must be 1.5748 in. (40 mm) to ensure coupling of the differential lock sleeve.

For models fitted with cabs the distance (H) between the base of the pedal and the top of the trim must be 0.7874 in. (20 mm).



138

If not, proceed as follows.

1. Remove the relative split pin and extract the pivot pin (6) on the fork (5).

2. Loosen: the locknut (4), nut (2) and the relative locknut inside the fork (1).

3. Screw or unscrew the tie-rod (3) and the fork (5) until the required height of the differential lock pedal from the top of the trim is obtained.

4. Secure: the nut (2), the relative locknut inside the fork (1) and the locknut (4).

5. Attach the pivot pin (6) with the relative split pin.

Op. 27 120 10
FINAL DRIVE CASING R.I.

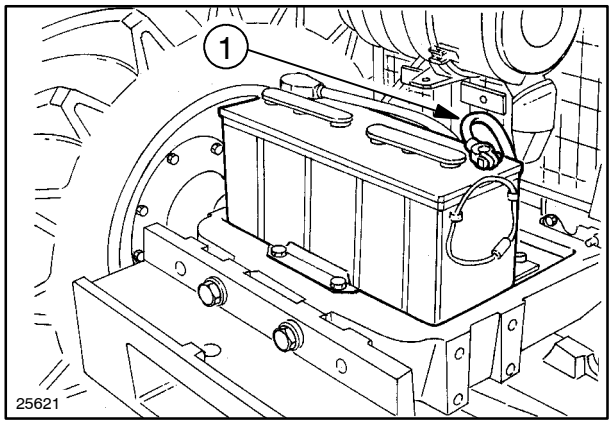
DANGER

Lift and handle all heavy parts using suitable lifting equipment.

Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

To remove the final drive casing proceed as follows.

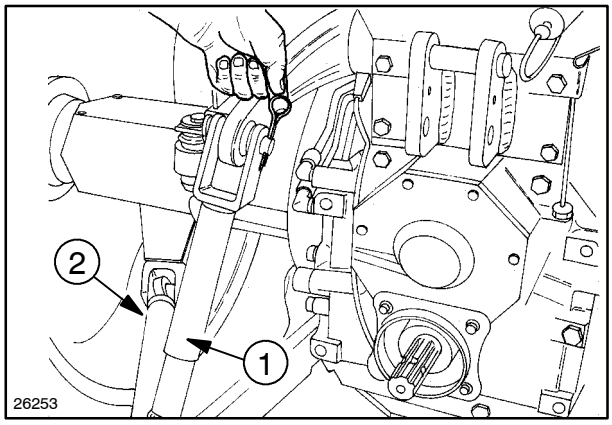
1. Disconnect the battery negative lead (1).



139

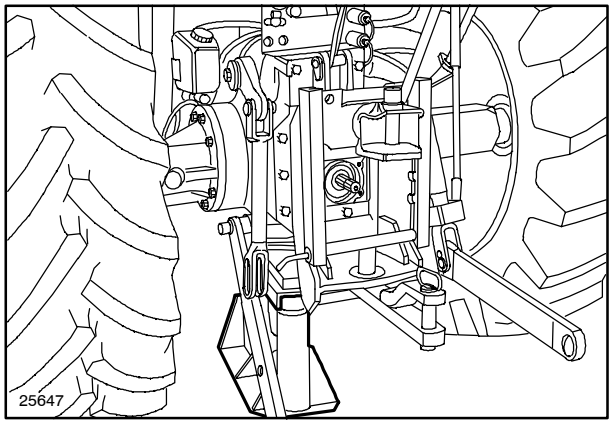
2. Lock the front wheels using chocks.

3. Detach the vertical tie-rod (1) and the LH anti-swing rod (2).



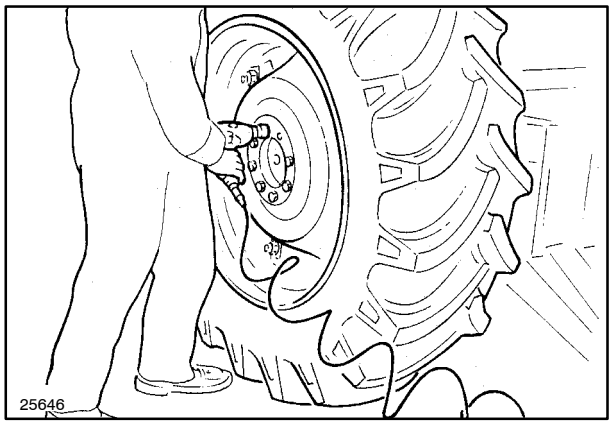
140

4. Raise the rear part of the tractor and position a fixed stand under the flex bar support.



141

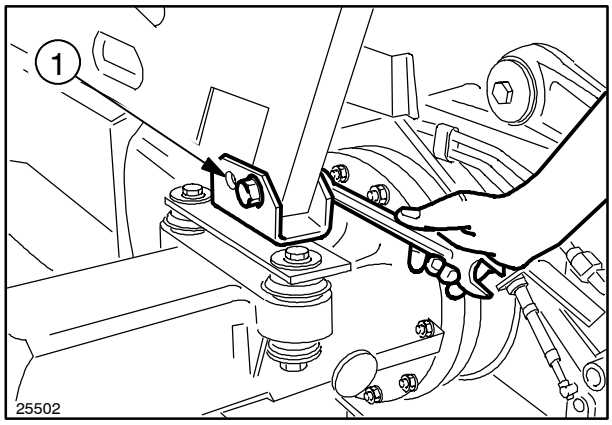
5. Unscrew the retaining bolts and remove the rear LH wheel.



142

6. Detach the window washer reservoir from the support bracket and disconnect the electrical connections and delivery lines.

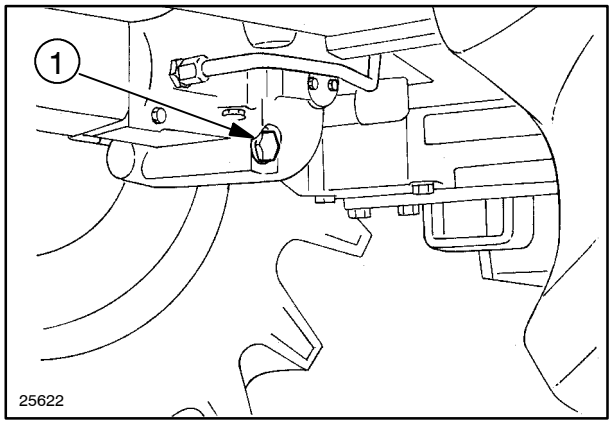
7. Take out the bolt securing the cab to the bracket (1).



143

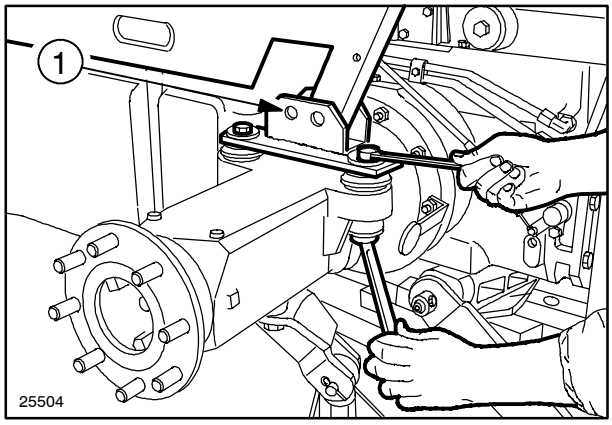
8. Slightly raise the cab and position a suitable piece of wood between the hydraulic lift and the cab, making sure that there is no contact with the piping.

9. Take out the plug (1) and drain the oil from the gearbox–rear transmission casing.



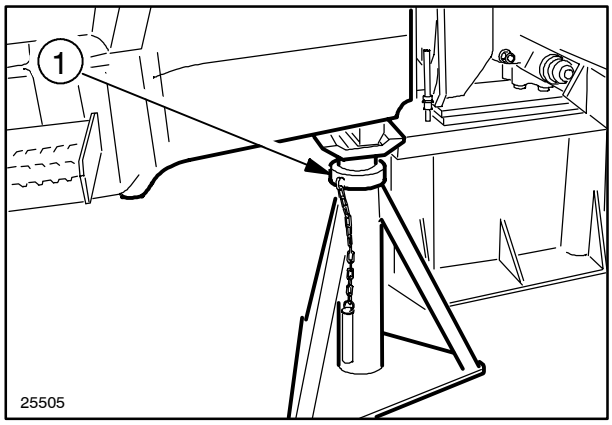
144

10. Take out the cab supporting bracket (1) retaining bolts.



145

11. Position a stand (1) under the rear part of the fuel tank.

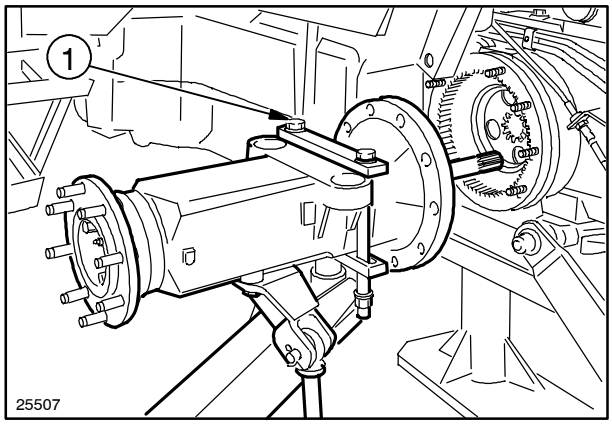


146

12. Connect the final drive casing to suitable equipment for lifting and retaining. Take out the retaining bolts and remove the final drive casing from the transmission casing.
13. To refit the final drive casing, proceed as follows.

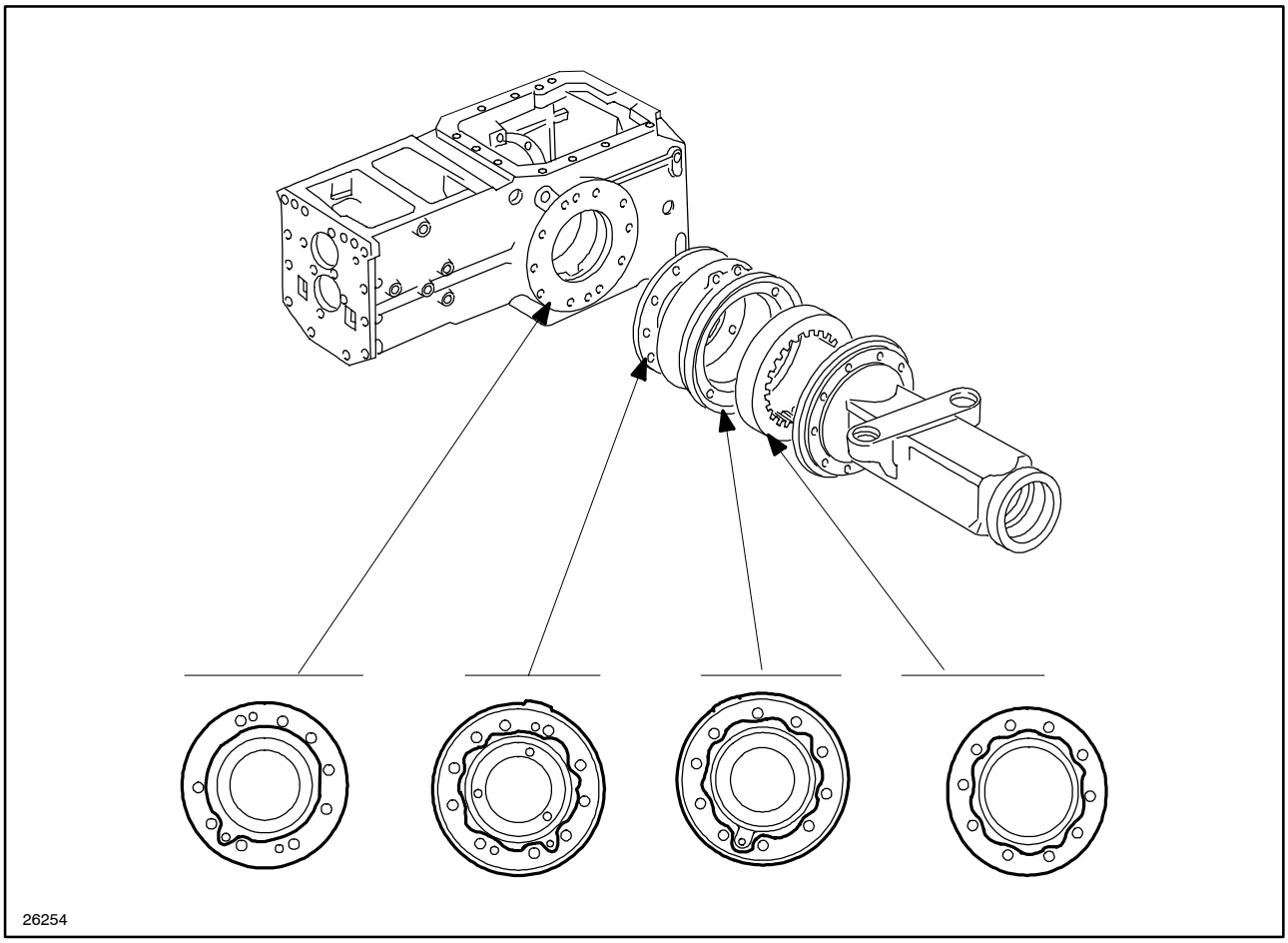
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



147

- Before refitting the casings, supports and covers clean and de-grease the mating surfaces and apply sealing compound (approx. 0.0787 in. (2 mm) in diameter) as shown in figure 85.
- Fit the final drive assembly using suitable equipment for lifting and retaining.
- Attach the cab support bracket.
- Remove the wooden block and secure the cab to the relative bracket.
- Fit the window washer reservoir.
- Assemble the rear LH wheel.
- Fit the stabiliser strut and the vertical rod.
- Screw the oil drain plug into the drive casing and replenish with oil: the prescribed product and quantity are stated in Section 00.
- Connect the battery negative lead.



148

Diagram of seal compound application for brake assembly and final drives on the transmission casing.

The types of sealing compound are listed on page 1, Section. 00.

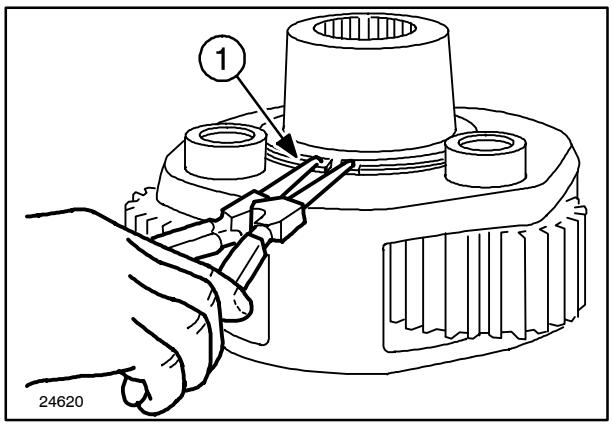
Op. 27 120 32
EPICYCLIC FINAL DRIVE D.A.

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

With the assembly detached from the housing, proceed as follows.

1. Remove the retaining ring (1).
2. Extract the pins and remove the gears, complete with the roller bearings.
3. Refit all epicyclic final drive parts by inverting operations 1 and 2.



149

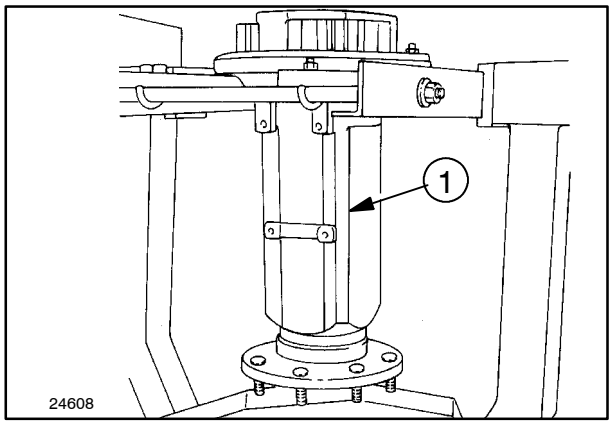
Op. 27 120 34
DRIVE WHEEL SHAFT D.A.

CAUTION

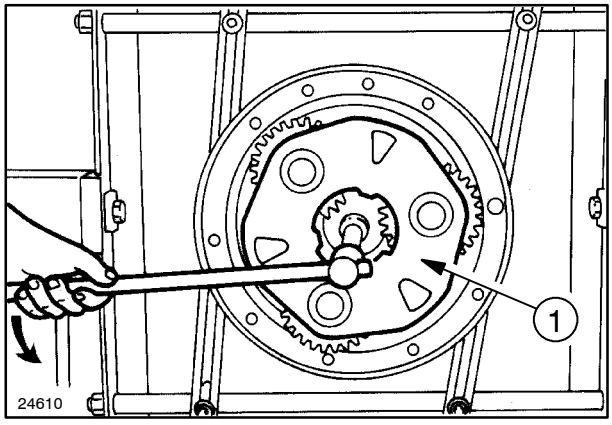
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

With the final drive casing removed from the rear transmission, proceed as follows.

1. Position the final drive casing (1) on a rotating stand.
2. Take out the bolt (1) securing the driven gear support on the drive wheel shaft and remove the safety plate.

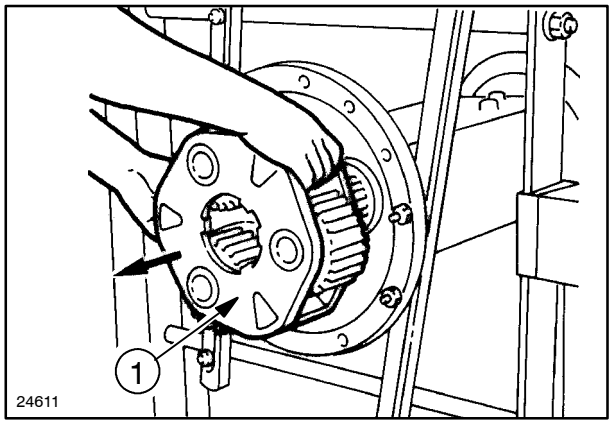


150



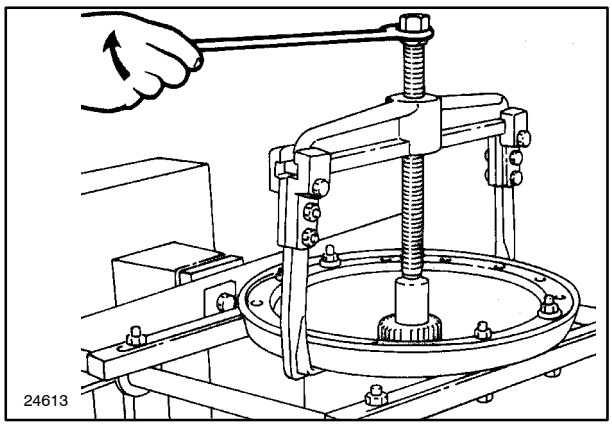
151

3. Extract the support (1) from the driven gears and remove the end float adjuster shim from the support.



152

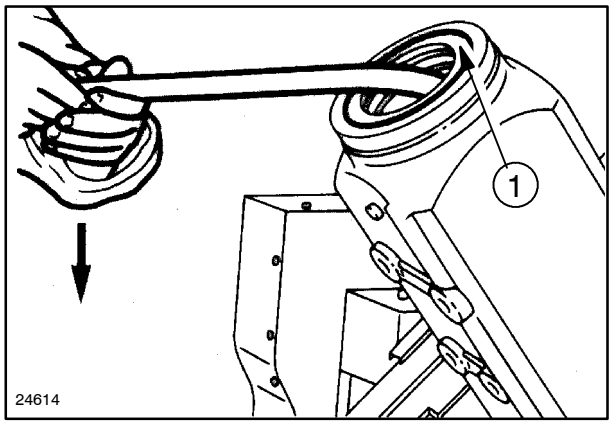
4. Using an extractor, extract the drive wheel shaft (1).



153

5. Remove the seal (1).
6. To refit the final drive casing, proceed as follows.

- For the correct orientation of the various parts, refer to the illustrations in figs. 10, 11, 12, 13 and 14.
- Respect the tightening torques prescribed on page 3.
- Fit the seal using a suitable striker.
- Assemble the drive wheel shaft.

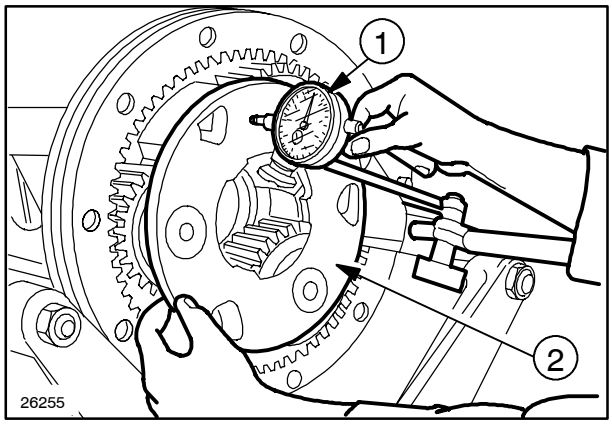


154

- Fit the driven gear support and the relative adjuster shim.
- Insert the safety plate and tighten the bolt to the prescribed torque.
- Adjust the end float of the gear support as follows.

7. Using a dial gauge (1), check that the end float of the support (2) is 0.0078 to 0.0157 in. (0.2 to 0.4 mm); if not, change the adjuster shim (10, figs. 12, 13 and 14).

NOTE: *The adjustment shims are listed on page 3.*



155

SECTION 31 - POWER TAKE-OFF

Chapter 1 - Mechanical power take-off

CONTENTS

Operation	Description	Page
	Data	2
	Tools	5
	Tightening Torques	6
	Cross-sectional views	7
	Description of operation	10
	Fault diagnosis	11
31 112 20	Power take-off housing R.I.	12
31 112 45	Power take-off driving shaft D.A.	15
31 112 48	Driven shaft and other parts D.A.	15

MECHANICAL POWER TAKE-OFF DATA

		TL70	TL80 TL90 TL100
540 rpm power take-off			
Type (two functions)		1. independent in relation to tractor speed or: 2. synchronized to gearbox	
Engagement and Control		mechanical, by means of hand lever located on the LH and RH side of the driving position (see page 10 and 11)	
Direction of rotation (from tractor rear)		clockwise	
Engine speed with PTO at 540 rpm	rev/min	2200	
PTO revolution speed with engine at max. power (2500 rpm)	rev/min	614	
PTO revolution speed synchronized with gearbox (18.64 mph (30 km/h) model)	wheel revs	8.2	8.9
PTO revolution speed synchronized with gearbox (4WD 24.85 mph (40 km/h) model)	wheel revs	6.73	7.25
Diameter of driven shaft at bearings	in. (mm)	1.9660 to 1.9685 (49.938 to 50.000)	
Diameter of driven shaft at grooved terminal		$1\frac{3}{8}$" (6 grooves)	
PTO 540/750 rpm (on request for all models)			
Type		same as 540 rpm PTO	
Engagement and Control		same as 540 rpm PTO	
Direction of rotation (from tractor rear)		same as 540 rpm PTO	
Speed Selection		by means of hand lever located on the rear RH side of the driver's seat	
Engine speed with PTO at 540 rpm	rev/min	2200	
Engine speed with PTO at 750 rpm	rev/min	2382	
PTO revolution speed with engine at max. power of 2500 rpm:			
- for 540 rpm PTO	rev/min	614	
- for 750 rpm PTO	rev/min	787	
PTO revolution speed (540 rpm) synchronized with gear-box 18.64 and 24.85 mph (30 and 40 km/h) models	wheel revs	see 540 rpm PTO	
PTO revolution speed (750 rpm) synchronized with gear-box (18.64 mph (30 km/h) model)	wheel revs	10.51	11.4

(continued)

MECHANICAL POWER TAKE-OFF DATA

(cont)

		TL70	TL80 TL90 TL100
PTO revolution speed (750 rpm) synchronized with gearbox (4WD 24.85 mph (40 km/h) model)	wheel revs	8.59	9.36
Diameter of driven shaft at grooved terminal		$1^3/_8$" (6 grooves)	
PTO 540/750/1000 rpm (on request for all models)			
Type		same as PTO 540/750 rpm	
Engagement and Control		same as PTO 540/750 rpm	
Direction of rotation (from tractor rear)		same as PTO 540/750 rpm	
Speed Selection		by means of hand lever located on the rear RH side of the driver's seat	
Engine speed with PTO at 540 rpm	rev/min	2200	
Engine speed with PTO at 750 rpm	rev/min	2382	
Engine speed with PTO at 1000 rpm	rev/min	2381	
PTO revolution speed with engine at max. power of 2500 rpm:			
- for 540 rpm PTO	rev/min	614	
- for 750 rpm PTO	rev/min	787	
- for 1000 rpm PTO	rev/min	1050	
For PTO revolution speed (540/750 rpm) synchronized with gearbox 18.64 and 24.85 mph (30 and 40 km/h) models	wheel revs	see PTO 540/750 rpm	
PTO revolution speed (1000 rpm) synchronized with gearbox (18.64 mph (30 km/h) model)	wheel revs	14.1	15.2
PTO revolution speed (1000 rpm) synchronized with gearbox (4 WD 24.85 mph (40 km/h) model)	wheel revs	11.51	12.4
Diameter of driven shaft at grooved terminal:			
- 540 rpm	rev/min	$1^3/_8$" (6 grooves)	
- 750 rpm	rev/min	$1^3/_8$" (6 grooves)	
- 1000 rpm	rev/min	$1^3/_8$" (21 grooves)	
External diameter of driven gear support bushings	in. (mm)	1.9655 to 1.9665 (49.925 to 49.950)	
Internal diameter of driven gears	in. (mm)	1.9704 to 1.9720 (50.050 to 50.089)	
Clearance between driven gears and bushings	in. (mm)	0.0039 to 0.0064 (0.100 to 0.164)	
Diameter of driven shaft at front and central bushings	in. (mm)	1.5419 to 1.5418 (39.166 to 39.191)	
Diameter of driven shaft at rear bushing	in. (mm)	1.3773 to 1.3779 (34.984 to 35.000)	
Internal diameter of front and central bushings	in. (mm)	1.5433 to 1.5448 (39.200 to 39.239)	
Internal diameter of rear bushing	in. (mm)	1.3783 to 1.3798 (35.009 to 35.048)	
Clearance between shaft and front and central bushings	in. (mm)	0.0003 to 0.0028 (0.009 to 0.073)	
Clearance between shaft and rear bushing	in. (mm)	0.0003 to 0.0002 (0.009 to 0.064)	

MECHANICAL POWER TAKE-OFF for TL90 and TL100 NORTH AMERICAN version (on request)

		TL90 and TL100
540/1000 rpm PTO		
Type (two functions)		1) independent with respect to tractor speed 2) not synchronized to gearbox
Engagement and Control		mechanical, by means of hand lever located on the LH and RH side of the driving position (see page 10 and 11)
Direction of rotation (from tractor rear)		clockwise
Engine speed with PTO at 540 rpm	rev/min	2200
Engine speed with PTO at 1000 rpm	rev/min	2381
PTO revolution speed with engine at max. power of 2500 rpm:		
- 540 rpm PTO	rev/min	614
- 1000 rpm PTO	rev/min	1050
Diameter of driven shaft at grooved terminal:		
- 540 rpm	rev/min	$1^3/_8$" (6 grooves)
- 1000 rpm	rev/min	$1^3/_8$" (21 grooves)
External diameter of driven gears support bushings	in. (mm)	1.9655 to 1.9665 (49.925 to 49.950)
Internal diameter of driven gears	in. (mm)	1.9704 to 1.9720 (50.050 to 50.089)
Clearance between driven gears and bushings	in. (mm)	0.0039 to 0.0064 (0.100 to 0.164)
Diameter of driven shaft at bushings for 540 and 1000 rpm power take-off gears	in. (mm)	1.5419 to 1.5429 (39.166 to 39.191)
Internal diameter of bushings for 540 and 1000 rpm power take-off gears	in. (mm)	1.5433 to 1.5448 (39.200 to 39.239)
Backlash between shaft and bushings for 540 and 1000 rpm p.t.o. gears	in. (mm)	0.0003 to 0.0028 (0.009 to 0.073)

TOOLS

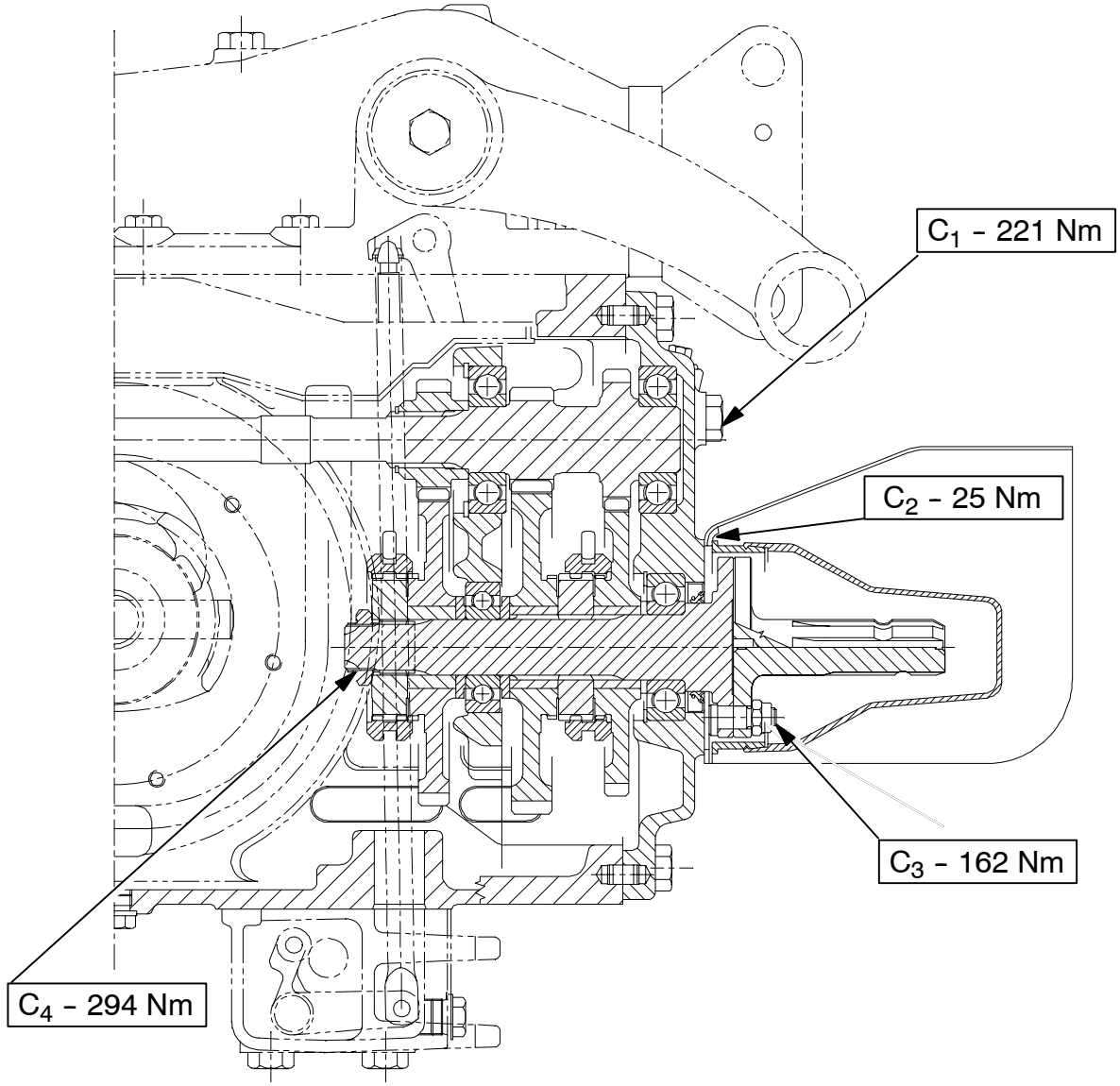
WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

380000227 Hook for lifting the power take-off.

380000233 Striker for PTO driving shaft bearings.

TIGHTENING TORQUES

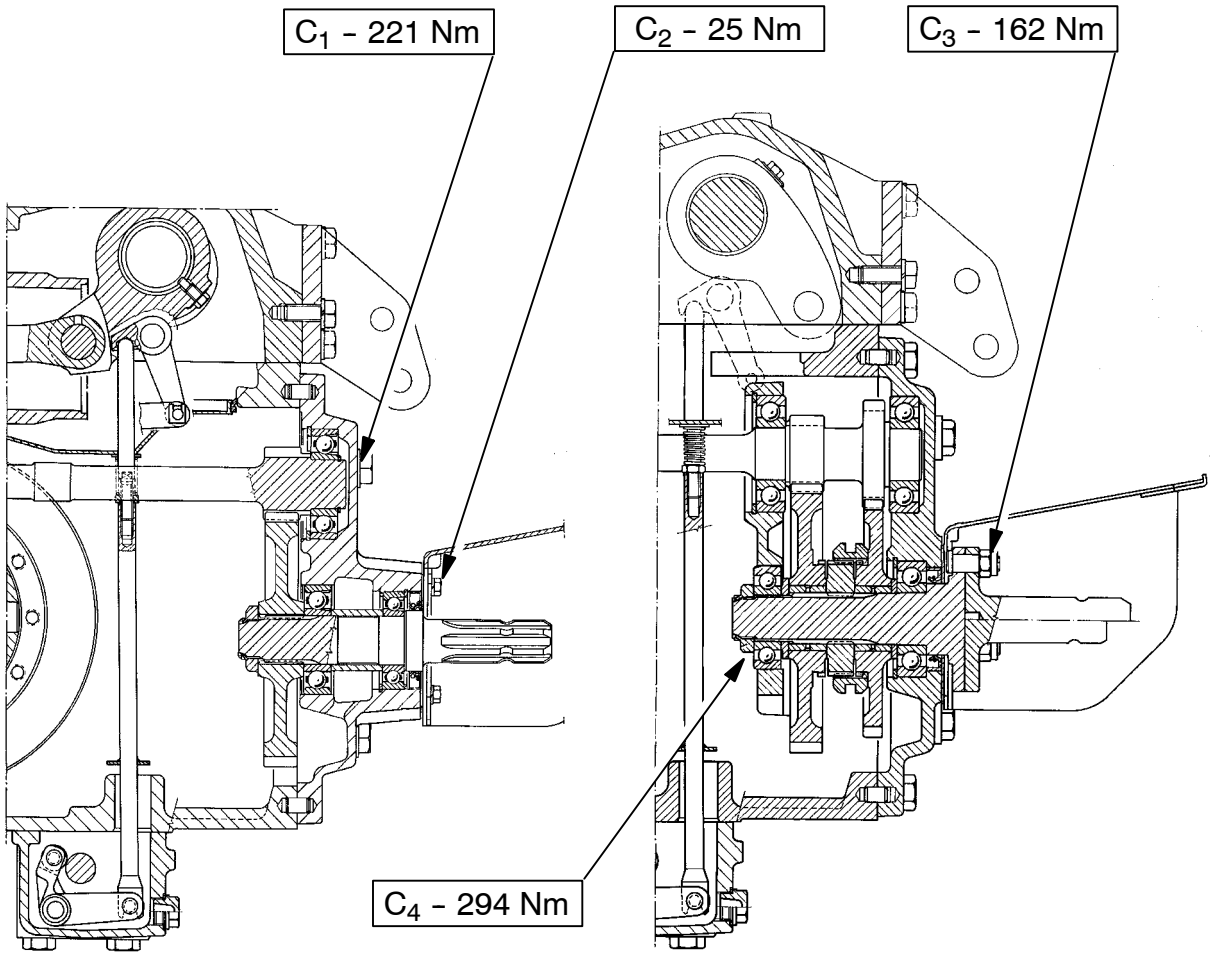


26277

540/750/1000 rpm power take-off

1

TIGHTENING TORQUES



540 rpm power take-off

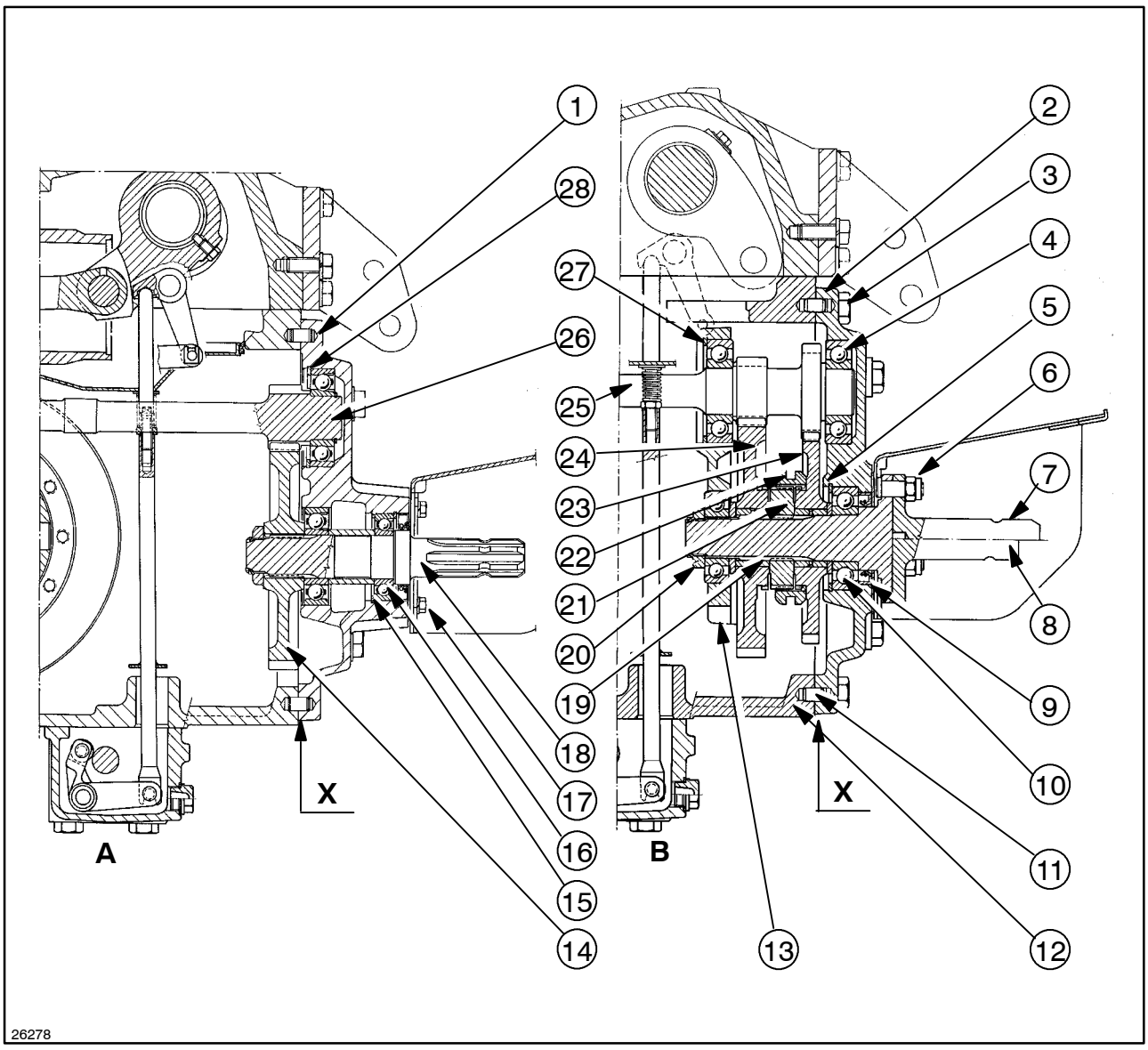
540/750 rpm power take-off

26276

2

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Bearing support retaining bolts (PTO 540/750 and 540/1000 rpm)	M 12 x 1.25	98	10
PTO casing retaining bolts (C_1, figs. 1 and 2)	M 16 x 1.5	221	22.5
PTO guard retaining bolts (C_2, figs. 1 and 2)	M 8 x 1.25	25	2.6
Self locking nuts for securing grooved terminal (C_3, fig. 2) for 540/750 rpm PTO and (C_3, fig. 1) for 540/750/1000 rpm PTO	M 12 x 1.25	162	16.5
Nut locking driven gear shaft:			
(C_4, fig. 2) for 540 rpm and 540/750 rpm PTO	M 32 x 1.5	294	30
(C_4, fig. 1) for 540/750/1000 rpm PTO	M 28 x 1.5	294	30

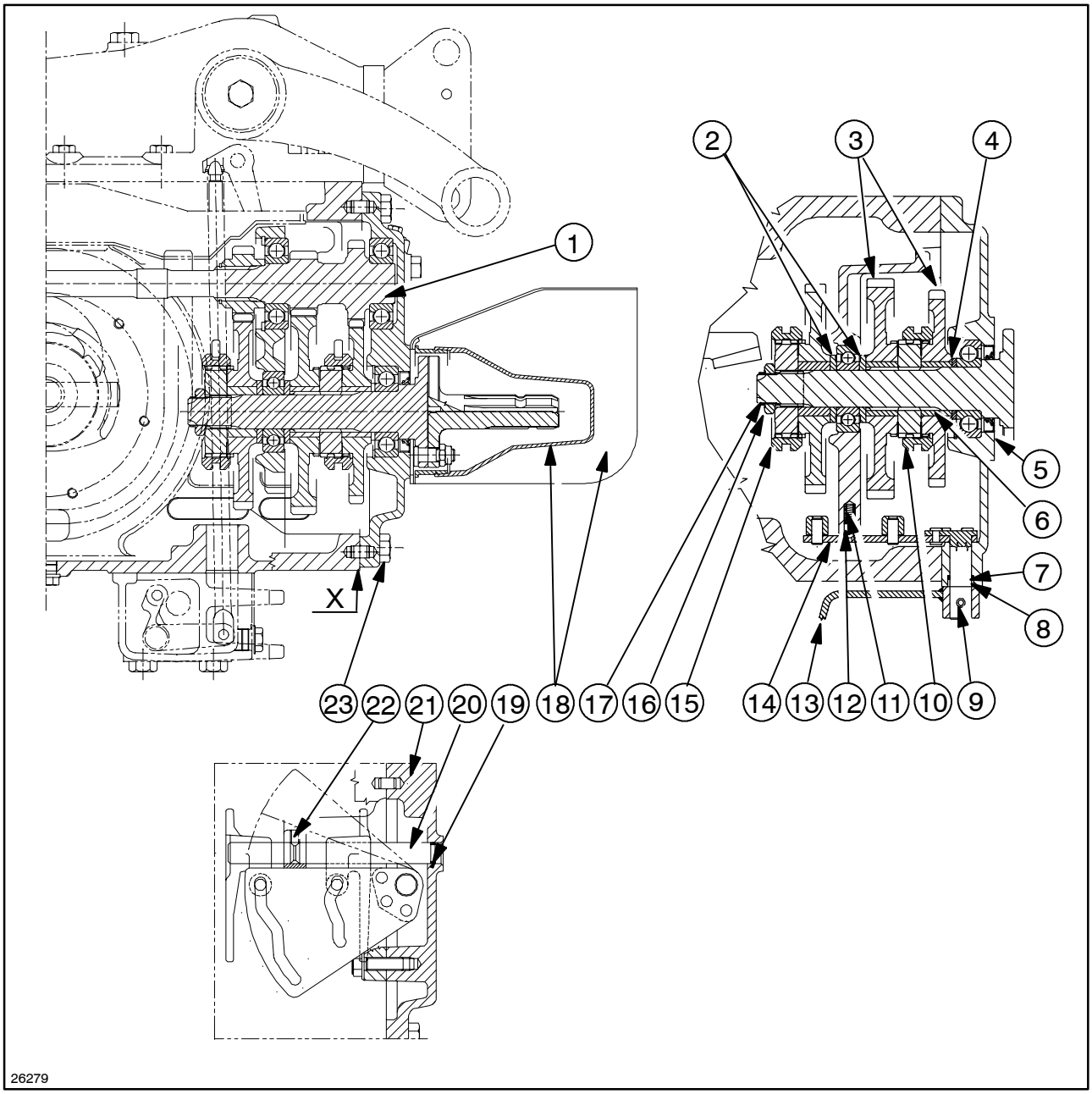


3

Longitudinal sectional diagrams of 540 rpm and 540/750 rpm PTO

A. Sectional diagram of 540 rpm PTO.
B. Sectional diagram of 540/750 rpm twin speed PTO.
1. 540 rpm PTO casing.
2. 540/750 rpm PTO cover.
3. PTO unit retaining bolt.
4. Drive shaft bearings.
5. Circlip.
6. Self locking nut for securing grooved terminal.
7. 540 rpm grooved terminal.
8. 750 rpm grooved terminal.
9. Seal.
10. Driven shaft bearings.
11. Cover centering pin.
12. Rear transmission casing.
13. Rear bearings support.
14. Driven gear.
15. Circlip.
16. Circlip.
17. PTO guard retaining bolts.
18. 540 rpm PTO driven shaft.
19. Driven gears support bushings.
20. Driven shaft lock nut.
21. Fixed gear.
22. Coupling sleeve.
23. Driven gear for 750 rpm speed.
24. Driven gear for 540 rpm speed.
25. Double driving gear.
26. Driving Gear
27. Circlip.
28. Circlip.

NOTE: *On assembly, apply the type of sealing compound noted on page 1, Section 00 on surface* ***X*** *following the diagram in fig. 21*.

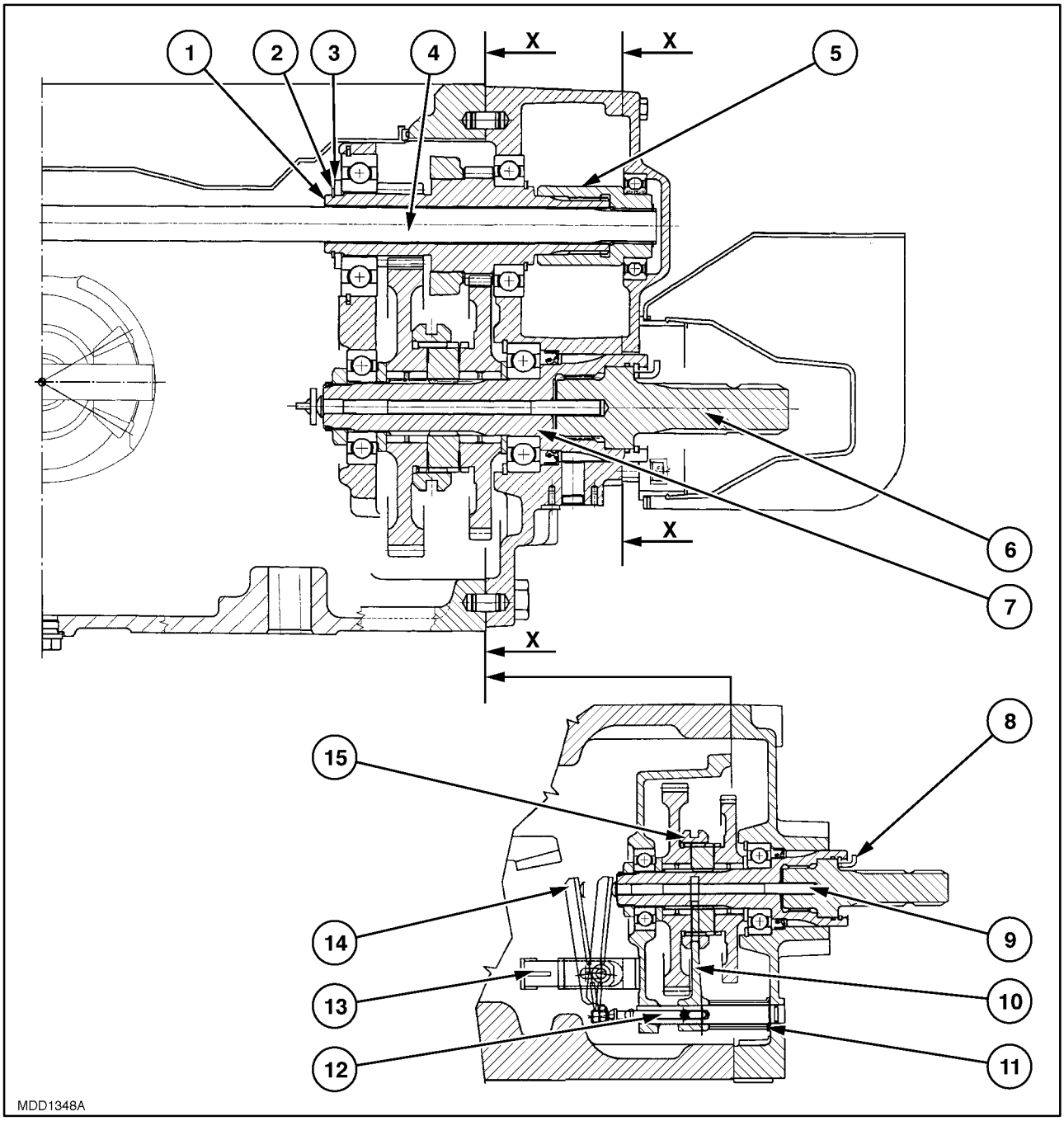


4

Cross-sectional views of 540 - 750 - 1000 rpm PTO

1. Drive shaft.
2. Thrust washers.
3. Driven gears.
4. Thrust washer.
5. Seal.
6. Driven gears bushings.
7. 'O' ring seal.
8. Washer.
9. Flexible pin.
10. 540 or 1000 rpm PTO coupling sleeves.
11. Spring.
12. Pawl.
13. External control lever.
14. Internal command device.
15. 750 rpm PTO coupling sleeve.
16. Driven shaft lock nut.
17. Driven Shaft.
18. Guards.
19. 'O' ring seal.
20. Control fork support rod.
21. PTO cover.
22. Rod retaining bolt (20).
23. PTO unit retaining bolt.

NOTE: *On assembly, apply the type of sealing compound noted on page 1, Section 00 on surface* ***X*** *following the diagram in fig. 21*.



5

Cross-sectional views of 540 - 1000 rpm PTOs for TL90 and TL100 NORTH AMERICAN version (on request) not synchronized with the gearbox with the mechanical speed selection device

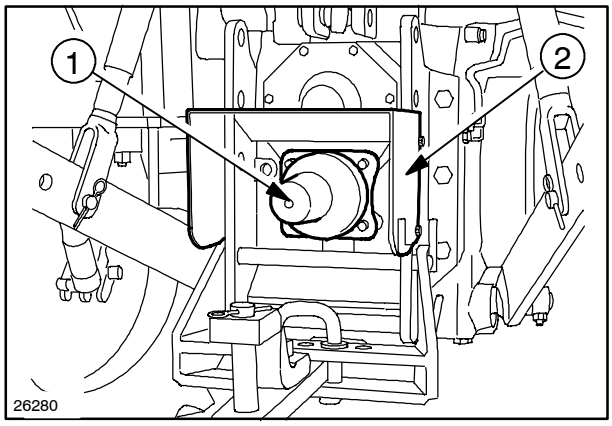
1. Shaft with driving gears.
2. Retaining snap ring (3).
3. Bearing thrust ring.
4. Flywheel drive shaft.
5. Drive gear shaft sleeve.
6. Grooved terminal 1 $^{3}/_{8}$" (6 grooves) for 540 rpm PTO or 1 $^{3}/_{8}$" (21 grooves) for 1000 rpm PTO.
7. Driven Shaft.
8. Retaining snap ring (6).
9. Speed selection pin.
10. Speed selection sleeve control fork.
11. Return spring.
12. Return pin.
13. Speed selection support lever.
14. Speed selection lever.
15. Speed selection sleeve.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *following the instructions and diagrams on page 30, chapter 2.*

DESCRIPTION AND OPERATION OF MECHANICAL PTO

The PTO (1) installed on the tractor transfers motion to the transported or towed implements. Control is either directly from the engine clutch or from the gearbox clutch.
Mechanically engaged/disengaged PTO devices are available in three versions:
- (standard) one speed, 540 rpm.
- (optional) twin speed, 540/750 rpm.
- (optional) three-speed, 540/750/1000 rpm.
- (on request)* two-speed 540/1000 rpm.

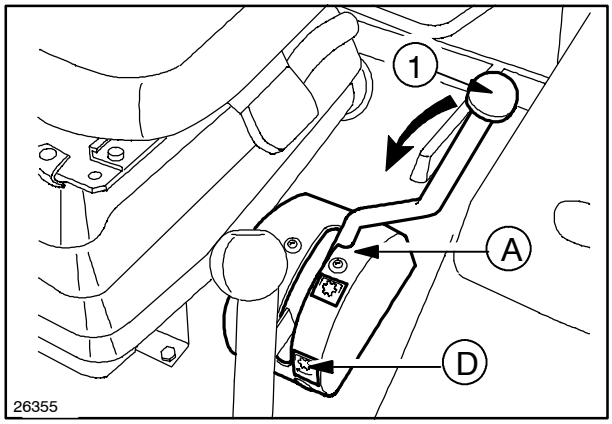
*** NORTH AMERICAN version**



6

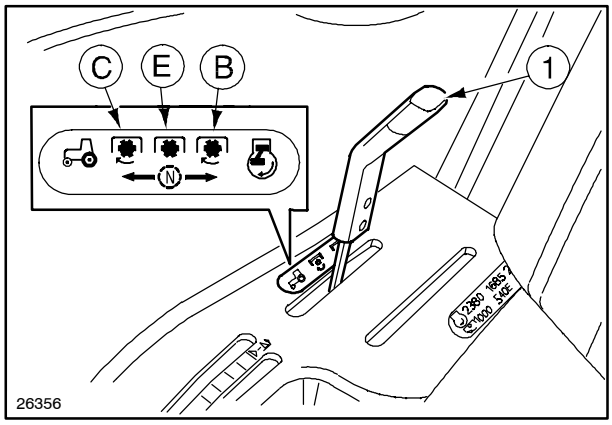
PTO controlled directly from the engine clutch

Proceed as follows:
- disengage the PTO clutch by moving the lever (1, fig. 7) to position A;
- move the operation selection lever (1, fig. 8) to position (B), thereby engaging the PTO sleeve (3, fig. 9) on the shaft gear coupling (2) which is moved by the main clutch;
- slowly engage the main clutch by moving the lever (1, fig. 7) to position D.



7

When engaged, the PTO grooved terminal rotates and the relevant lamp on the dashboard illuminates. In these conditions PTO operation is completely independent from the tractor travel, therefore:
- halt the tractor without stopping the power take-off;
- stop the power take-off without halting the tractor (by disengaging the power take-off clutch).
- To disengage the PTO move selection lever (1, fig. 8) to position E.



8

PTO synchronised with gears

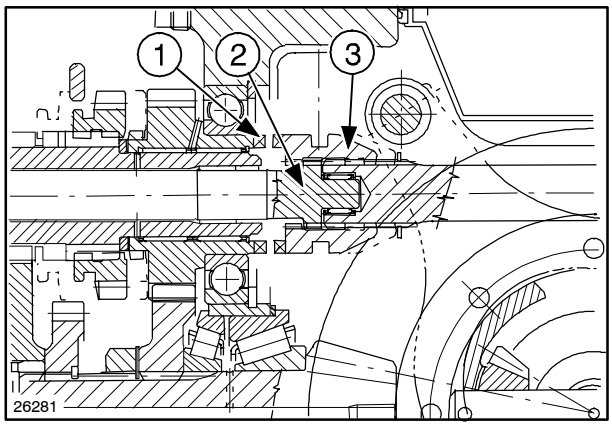
Proceed as follows:

- hold clutch lever (1, fig. 7) in position D;
- fully press the main gear clutch pedal;
- wait briefly, then move the lever (1, fig. 8) to position C and release the main gear clutch pedal;

In these conditions the PTO coupling sleeve (3, fig. 9) is directly driven by the main gear toothed coupling (1).

When the tractor is stationary, the synchronized PTO does not rotate; reverse the direction of rotation of the output shaft by moving from forward gear to reverse.

NOTE: *When the PTO is not in use, move lever (1, fig. 8) to position (E), in relation to the neutral position of the PTO coupling sleeve (3, fig. 9).*



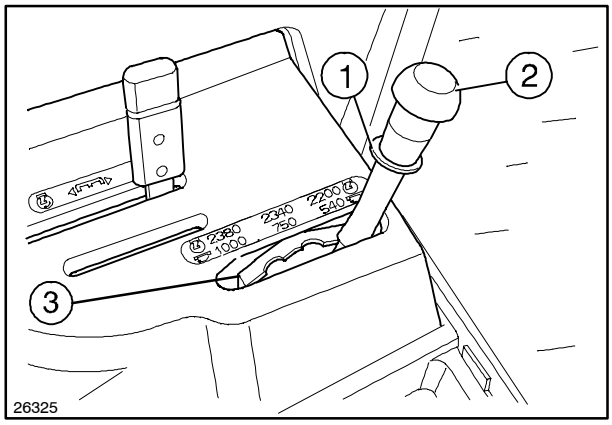
9

Selecting the speed with the lever (2, fig. 10)

To select power take-off speeds, proceed as described below:

- pull the stop knob (1) upwards;
- position lever (2) in the required speed sector (3).

This activates the external control lever (13, fig. 4) by means of a tie-rod. The external control lever rotates the internal cam device (14) and selects the required PTO speed by means of coupling sleeves (10 and 15).



10

MECHANICAL PTO TROUBLESHOOTING

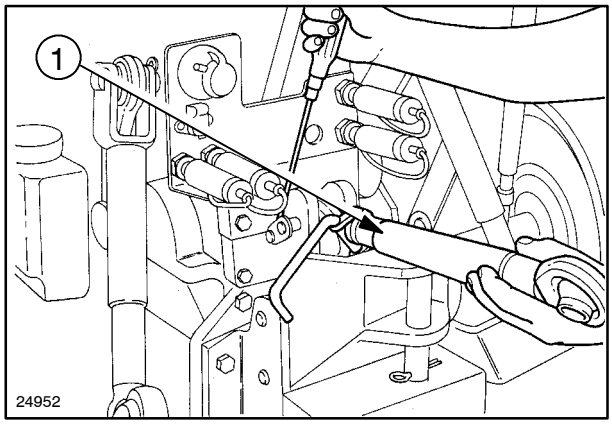
Problems	Possible Causes	Solutions
Slipping with speed loss on PTO grooved terminal.	Wear of clutch disk or of engine flywheel pressure plate. Incorrect adjustment of PTO clutch lever.	Check the data on the appropriate pages in Section 18, replace the worn parts and adjust the clutch lever.
Difficulty in selecting PTO speed by means of lever 2, fig. 10.	External control stiff or incorrectly adjusted.	Lubricate the control cable sheath. Adjust the control.

Op. 31 112 20
PTO HOUSING R.I.

DANGER

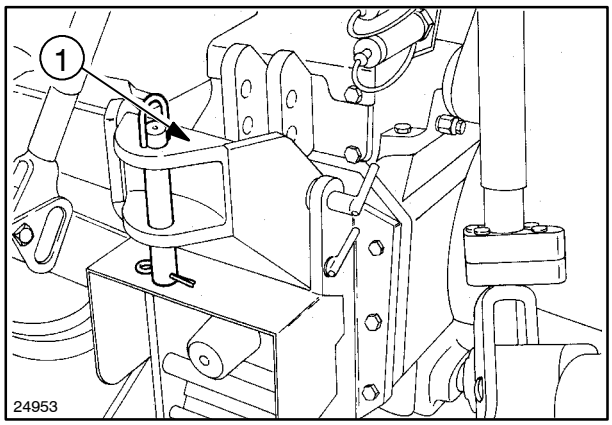
Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

1. Disconnect the battery negative cable.
2. Detach the three-point linkage (1).



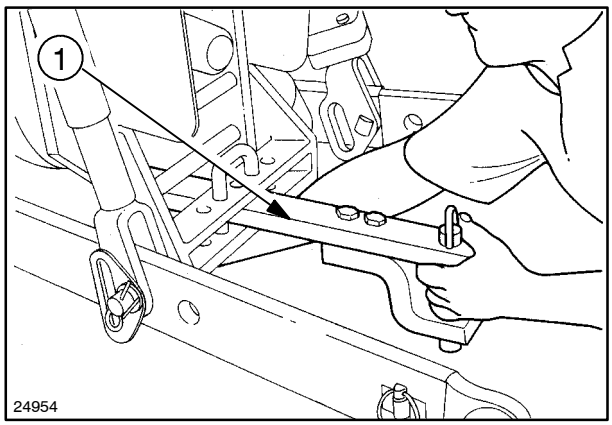
11

3. Detach the tow bar hook (1).



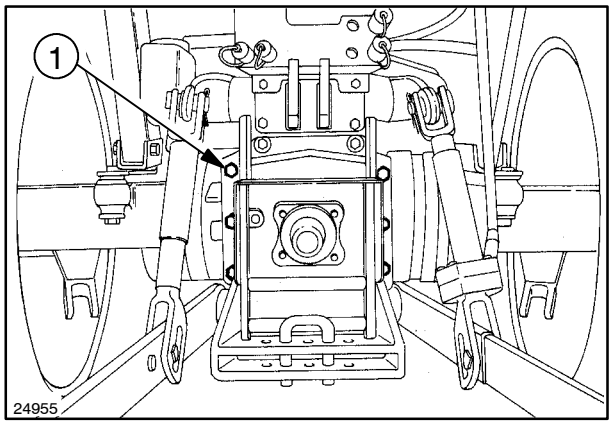
12

4. Remove the tow bar (1).



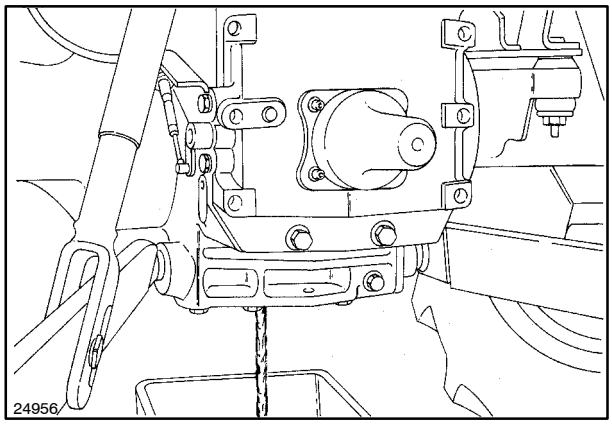
13

5. Remove the six retaining bolts (1) securing the towbar hook.



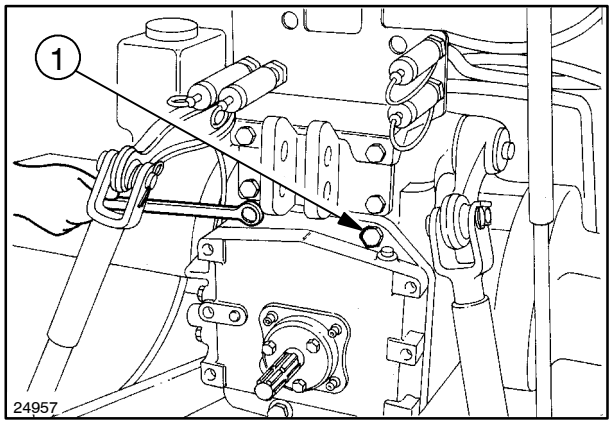
14

6. Drain the oil from the transmission/gearbox into a suitable container.



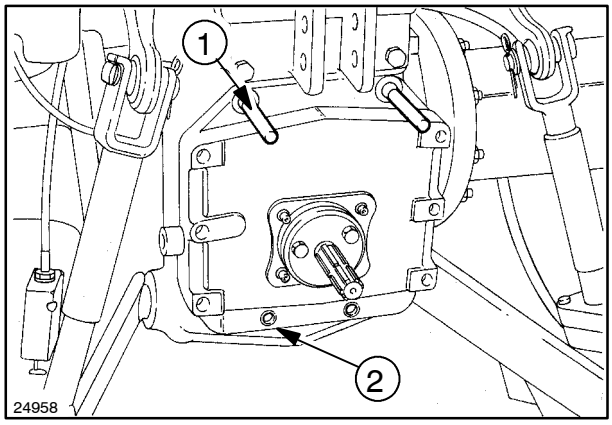
15

7. Remove the two upper bolts (1) securing the PTO unit to the transmission.



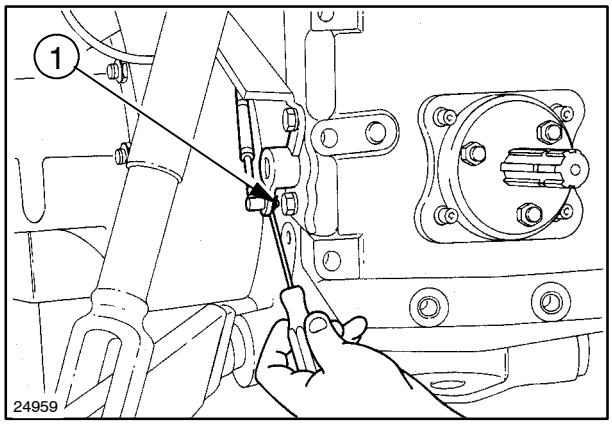
16

8. Insert the two guide pins (1) and unscrew the two lower bolts (2) securing the PTO unitto the transmission.



17

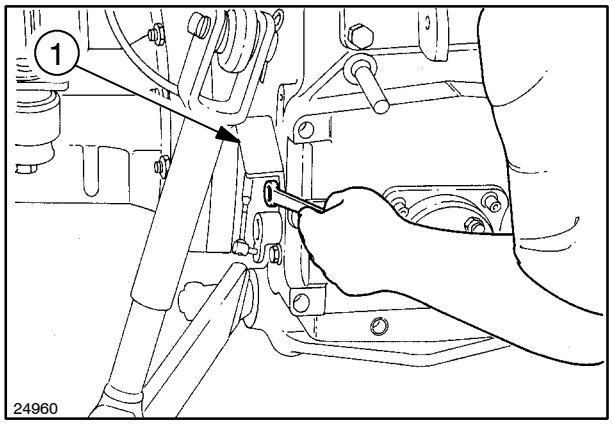
9. Remove the pin spring (1) and detach the PTO speed selection cable.



18

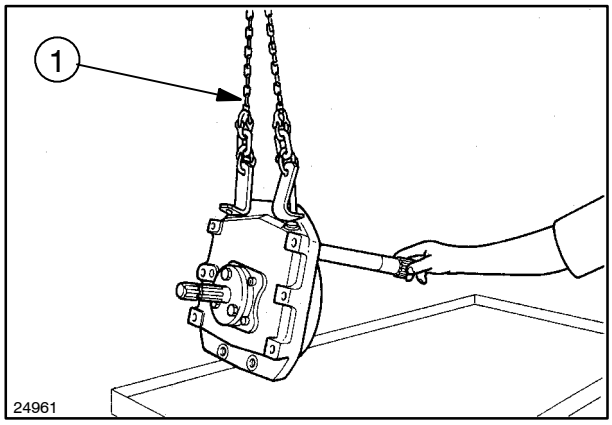
10. Unscrew the PTO speed selection cable sheath bracket (1) retaining bolts.
11. Move lever (1, fig. 8) to position (C), PTO synchronized with gears, so that the sleeve (3, fig. 9) remains on the shaft (2) during the removal operation.

    Extract the PTO unit by a few centimeters and remove using a hook and lifting chain **380000227** (1).



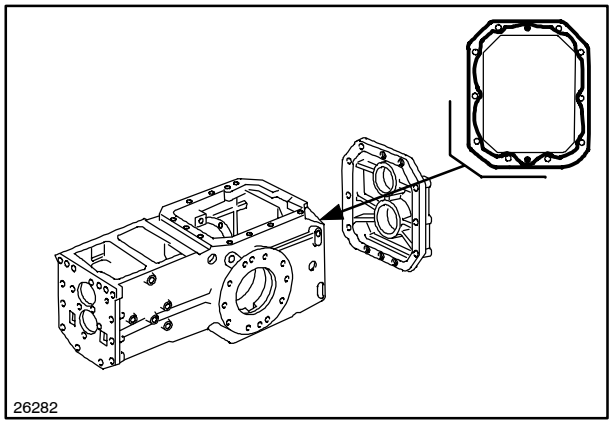
19

To assemble, proceed as follows:
- Clean the contact surface between the transmission casing and the PTO casing and apply sealing compound as indicated in fig. 21.
- Clean the mating surface on the PTO unit.
- Raise and position the PTO unit in front of the transmission casing and insert on the previously installed guide pins.
- Detach the hook and chain (1, fig. 20) and secure the PTO unit with the four bolts.
- Remove the two guide pins.



20

- Refit the PTO speed selection cable sheath bracket (1, fig. 19), connect the cable to the lever and insert the pin and spring (1, fig. 18).
- Reassemble the towbar hook assemble support.
- Refit the towbar hook and three-point bar.
- Tighten the drainage plug and then fill up the transmission/gearbox casing.
- Connect the battery negative lead.



21

Op. 31 112 45 e 31 112 48
MECHANICAL POWER TAKE-OFF SHAFTS D.A.

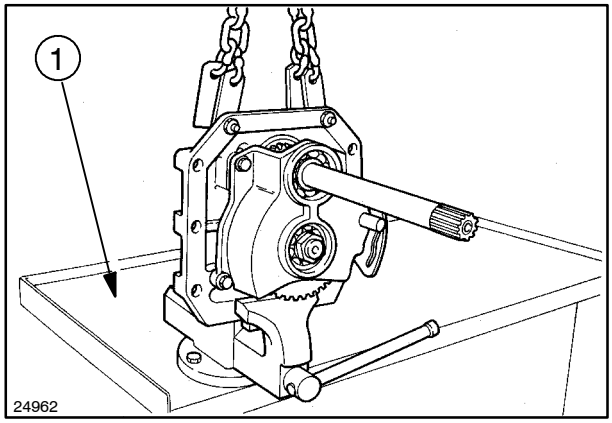
CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

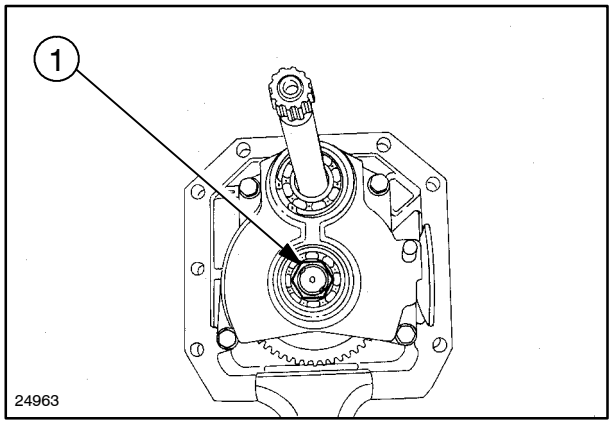
Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Position the PTO unit in a vice on a workbench (1).



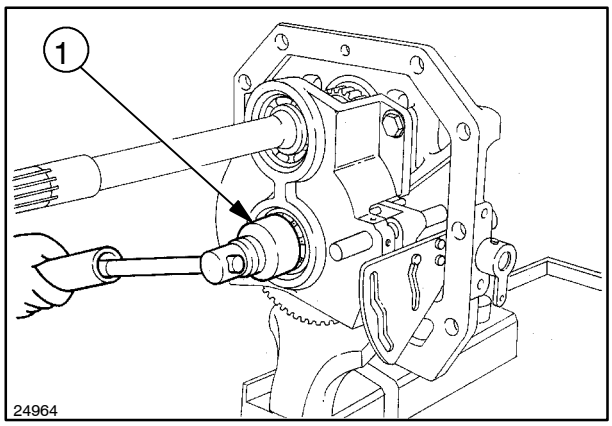
22

2. Using a punch, release the securing ring (1) on the driven shaft ring nut.



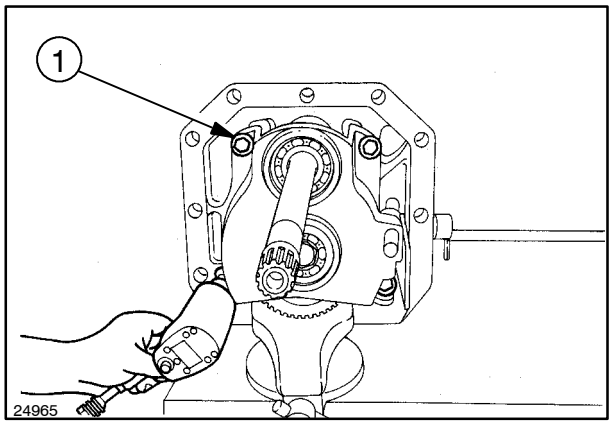
23

3. Remove the driven shaft ring nut (1).



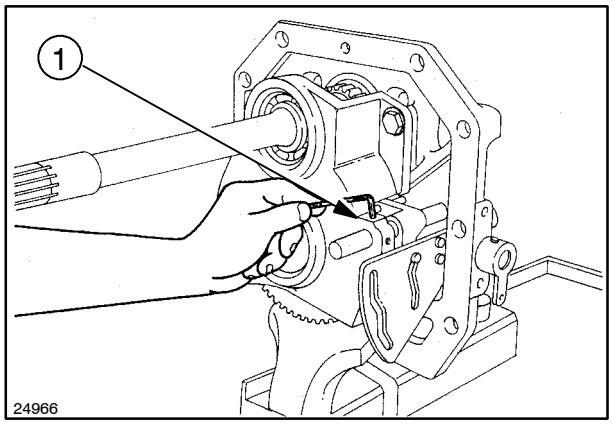
24

4. Remove the four retaining bolts (1) securing the PTO unit internal support.



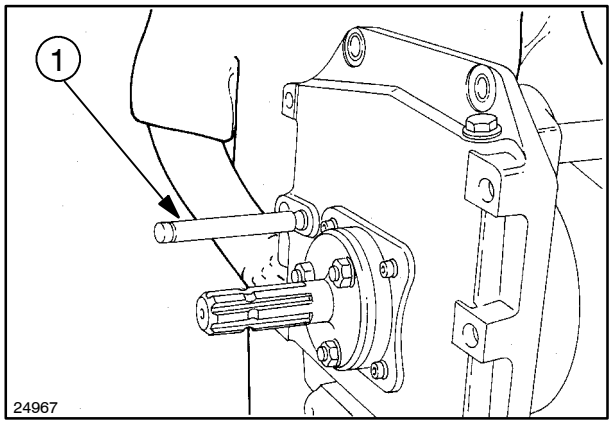
25

5. Remove the fork rod Allen screw (1).



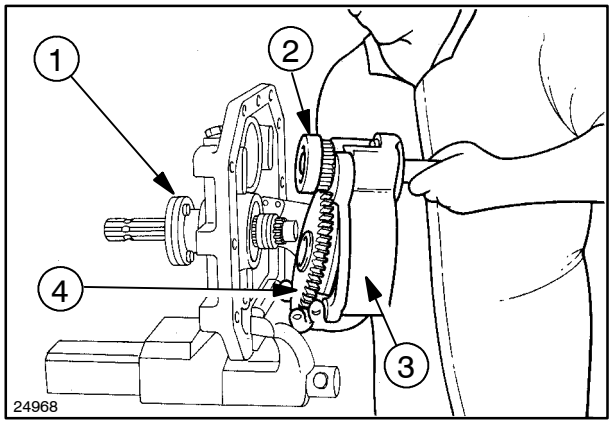
26

6. Extract the rod (1) from the rear casing.



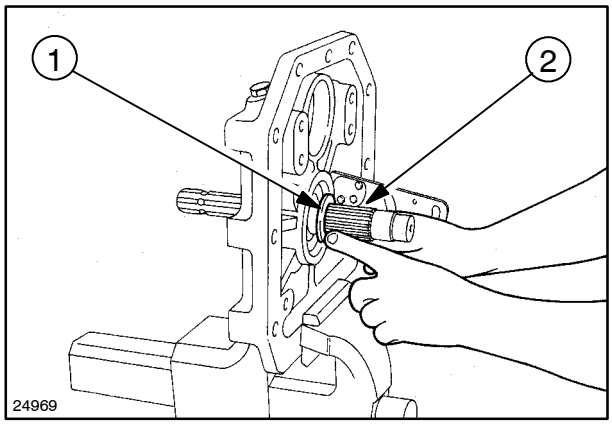
27

7. Partially extract the end of the shaft (1), remove the internal support (3) together with the driving shaft (2), the driven gears (4), the engaged/disengaged/neutral fork and sleeve, the 540/750 PTO; also remove the bearing thrust washer on the gearing side (24, fig. 3).



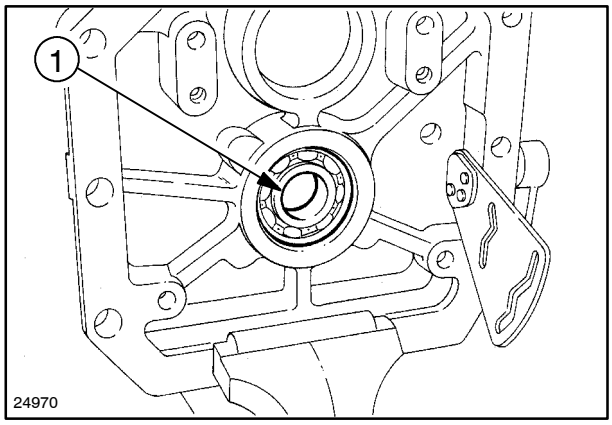
28

8. Remove the rear bearing thrust washer (1) and the transmission shaft (2), together with the PTO terminal.



29

9. Remove the retaining circlip, bearing (1) and seal (if it is to be changed) from the rear cover.



30

For assembly (see figure 3B) proceed as follows:

- Fit the seal (9, if it needs to be replaced), the rear bearing and the snap ring (5) on the rear cover.
- Refit the driven shaft with the thrust washer.
- Refit the driven shaft gear (23), the fixed gear (21), the sleeve (22), the fork and fork support rod.
- Insert the gear (24) on the driven shaft, assemble the internal support (13) together with the driving shaft (25). Secure the support (13) with the four bolts, tightening to the torque value noted on page 6.
- Fit the thrust washer on the gear (24), install the bearing on the internal support (13) of the driven shaft.
- Secure the rod that supports the PTO speed selection fork with the Allen screw.
- Tighten the driven shaft ring nut to the torque value noted on page 6, secure the ring nut to prevent it from loosening.

SECTION 31 - POWER TAKE-OFF

Chapter 2 - Electro-hydraulic power take-off

CONTENTS

Operation	Description	Page
	Data	2
	Tools	5
	Tightening Torques	6
	Cross-sectional views	7
	Description, operation and hydraulic diagrams	13
	Fault diagnosis	24
31 114 64	Power take-off clutch brake Replacement	25
31 116 21	Electro-hydraulic power take-off housing R.I.	27
31 116 47	Speed selection control device D.A.	31
31 116 55	Power take-off driving shaft D.A.	31
31 116 58	PTO driven shaft D.A.	31
	Services control valve R.I.	(See operation **23 202 20**)
	Services control valve for tractors without Dual command (2 Speed Power Shift) D.A.	(See operations **23 202 24 - 23 202 29)**

ELECTRO-HYDRAULIC PTO DATA

		TL70	TL80 TL90 TL100
540 rpm power take-off (standard for models TL100 on request for all the other models)			
Type (two functions, see page 19)		1. independent in relation to tractor speed or: 2. synchronized to gearbox	
Engagement and control (see page 13)		1. electrohydraulic/mechanical by means of knob and hand lever 2. mechanical, by means of hand lever located to the RH side of the driving position	
Direction of rotation (from tractor rear)		clockwise	
Engine speed with PTO at 540 rpm	rev/min	2200	
PTO revolution speed with engine at max. power of 2500 rpm	rev/min	614	
PTO revolution speed synchronized with gearbox (30 km/h model)	wheel revs	8.2	8.9
PTO revolution speed synchronized with gearbox (4 WD 40 km/h model)	wheel revs	6.73	7.25
Diameter of driven shaft (6, fig. 6) at rear bearing	in. (mm)	1.5741 to 1.5748 (39.984 to 40.000)	
Diameter of driven shaft (6) at front bearing	in. (mm)	1.3773 to 1.3779 (34.984 to 35.000)	
Diameter of shaft at grooved terminal		$1^3/_8$" (6 grooves)	

(continued)

ELECTRO-HYDRAULIC PTO DATA

(cont)

		TL70	TL80 TL90 TL100
540/1000 rpm PTO **(NASO version on request)**			
Type		independent in relation to tractor speed	
Engagement and Control		electrohydraulic by means of knob	
Direction of rotation (from tractor rear)		clockwise	
Speed Selection		Activated, by means of an internal mechanical device, replacing the grooved shaft (see page 19)	
Engine speed with PTO at 540 rpm	rev/min	2200	
Engine speed with PTO at 1000 rpm	rev/min	2381	
PTO revolution speed with engine at max. power of 2500 rpm:			
- 540 rpm PTO	rev/min	614	
- 1000 rpm PTO	rev/min	1050	
PTO revolution speed (540 rpm) synchronized with gear-box (18.64 and 24.85 mph (30 and 40 km/h) models)	wheel revs	see 540 rpm PTO	
PTO revolution speed (1000 rpm) synchronized with gear-box (18.64 mph (30 km/h) model)	wheel revs	14.1	15.2
PTO revolution speed (1000 rpm) synchronized with gear-box (4 WD 24.85 mph (40 km/h) model)	wheel revs	11.5	12.4
Diameter of shaft at grooved terminal (540 rpm)		$1^3/_8$" (6 grooves)	
Diameter of shaft at grooved terminal (1000 rpm)		$1^3/_8$" (21 grooves)	
540/750/1000 rpm power take-off **(optional for all models)**			
Type		see 540 rpm PTO	
Engagement and Control		see 540 rpm PTO	
Direction of rotation (from tractor rear)		clockwise	
Speed Selection		by means of hand lever (see page 15)	
Engine speed with PTO at 540 rpm	rev/min	2200	
Engine speed with PTO at 750 rpm	rev/min	2382	
Engine speed with PTO at 1000 rpm	rev/min	2381	
PTO revolution speed with engine at max. power of 2500 rpm:			
- for 540 rpm PTO	rev/min	614	
- for 750 rpm PTO	rev/min	787	
- for 1000 rpm PTO	rev/min	1050	
PTO revolution speed (540 rpm) synchronized with gear-box (18.64 and 24.85 mph (30 and 40 km/h) models)	rev/ wheel rev	see 540 rpm PTO	

(continued)

ELECTRO-HYDRAULIC PTO DATA

(cont)

		TL70	TL80 TL90 TL100
PTO revolution speed (750 rpm) synchronized with gearbox (18.64 mph (30 km/h) model)	wheel revs	10.51	11.4
PTO revolution speed (750 rpm) synchronized with gearbox (4 WD (24.85 mph (40 km/h) model)	wheel revs	8.59	9.36
PTO revolution speed (1000 rpm) synchronized with gearbox (18.64 mph (30 km/h) model)	wheel revs	14.1	15.2
PTO revolution speed (1000 rpm) synchronized with gearbox (4 WD (24.85 mph (40 km/h) model)	wheel revs	11.51	12.4
Diameter of shaft at grooved terminal (15, fig. 3):			
- 540 rpm		$1\,^3/_8$" (6 grooves)	
- 750 rpm		$1\,^3/_8$" (6 grooves)	
- 1000 rpm		$1\,^3/_8$" (21 grooves)	
External diameter of driven gear support bushings (18 and 21)	in. (mm)	1.9655 to 1.9665 (49.925 to 49.950)	
Internal diameter of driven gears (3 and 19)	in. (mm)	1.9704 to 1.9720 (50.050 to 50.089)	
Clearance between driven gears and bushings	in. (mm)	0.0039 to 0.0064 (0.100 to 0.164)	
Diameter of driven shaft (22) at front and central bushings (18)	in. (mm)	1.5419 to 1.5429 (39.166 to 39.191)	
Diameter of driven shaft (22) at rear bushing (21)	in. (mm)	1.3773 to 1.3779 (34.984 to 35.000)	
Internal diameter of front and central bushings (18)	in. (mm)	1.5433 to 1.5448 (39.200 to 39.239)	
Internal diameter of rear bushing (21)	in. (mm)	1.3783 to 1.3798 (35.009 to 35.048)	
Clearance between shaft (22) and front and central bushings (18)	in. (mm)	0.0003 to 0.0028 (0.009 to 0.073)	
Clearance between shaft (22) and rear bushing (21)	in. (mm)	0.0003 to 0.0025 (0.009 to 0.064)	
Clutch driving disk (11)	qty	5	
Clutch driven disk (12)	qty	5	
Clutch driving disk thickness (11)	in. (mm)	0.0787 ± 0.0019 (2 ± 0.05)	
Clutch driven disk thickness (12)	in. (mm)	0.0905 ± 0.0019 (2.3 ± 0.05)	
Piston return spring (10) (length with spring free)	in. (mm)	2.4015 (61)	
Piston return spring (10) (spring length under load of 225.53 ± 11.02 (102.3 ± 5 kg)	in. (mm)	1.3385 (34)	
Pressure relief valve lubrication spring (12, fig. 4) (length with spring free)	in. (mm)	1.1417 (29)	
Pressure relief valve lubrication spring (12) (length under load of 17.85 ± 0.88 (8.1 ± 0.4 kg)	in. (mm)	0.8661 (22)	
Pressure relief valve lubrication calibration	psi (bar)	63.81 to 85.57 (4.4 to 5.9)	
Spring free length (5), for valve (4) locking disks (11 and 12, fig. 3) and rear bearing lubrication (13)	in. (mm)	2.2440 (57)	
Spring length (5, fig. 4) under load of 5.46 ± 0.22 (2.48 ± 0.1 kg)	in. (mm)	1.4173 (36)	
Valve diameter (4)	in. (mm)	0.4719 to 0.4722 (11.988 to 11.996)	
Valve seat diameter (4) on relative support	in. (mm)	0.4730 to 0.4736 (12.016 to 12.030)	
Clearance between valve (4) and relative seat on support	in. (mm)	0.0007 to 0.0016 (0.020 to 0.042)	
Accumulator spring (14) (spring free)	in. (mm)	4.8031 (122)	
Accumulator spring (14) (spring under load of 76.94 ± 3.7478 (34.9 ± 1.7 kg)	in. (mm)	3.9370 (100)	

(continued)

DATA ON CONTROL VALVE WITH SOLENOID VALVES

(cont)

		TL70	TL80 TL90 TL100
Coupling clearance between control valve rod (11, fig. 7) and seat	in. (mm)	0.0009 to 0.0013 (0.025 to 0.035)	
Coupling clearance between pressure relief valve (20) and seat	in. (mm)	0.0009 (0.025)	
Pressure relief valve spring (18) (with spring free	in. (mm)	5 (127)	
Pressure relief valve spring (18) (spring length under load of 65.47 ± 2.86 (29.7 ± 1.30 kg)	in. (mm)	4.0354 (102.5)	
Pressure relief valve (20) setting	psi (bar)	227.72 to 242.22 (15.7 to 16.7)	

TOOLS

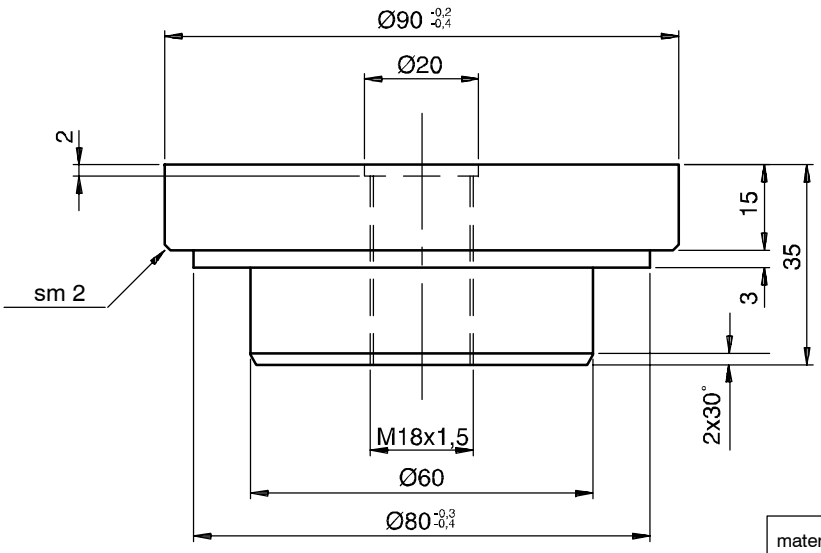
WARNING

The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

380000227 Hook for lifting the power take-off.

380000243 Press for clutch spring.

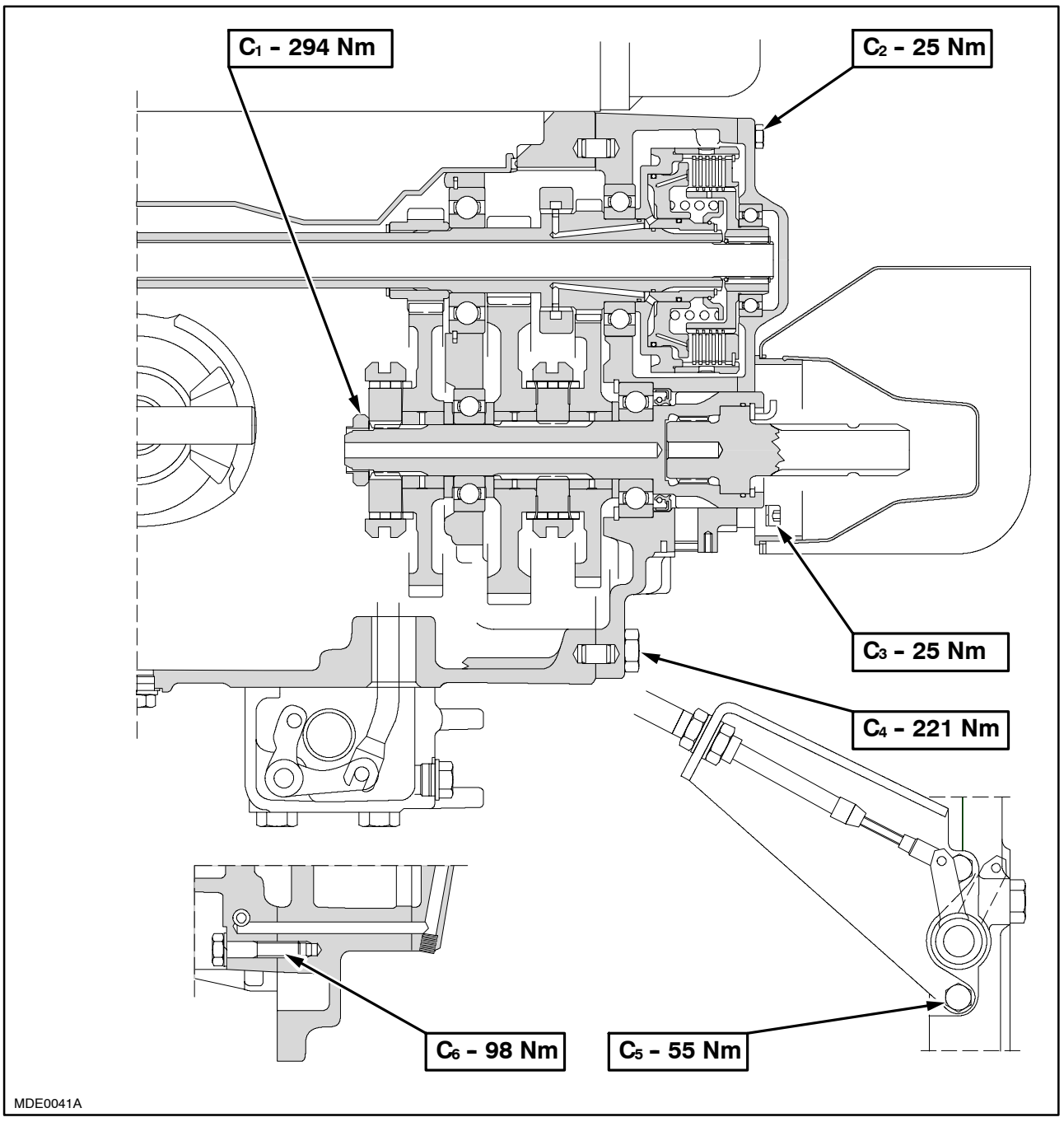
380000258 Handgrip (with **50135**).



material	**UNI C 40**
qty	**1**
Models	**JXU Series**
Tool number	**50135**

Striker (to use with 380000258)

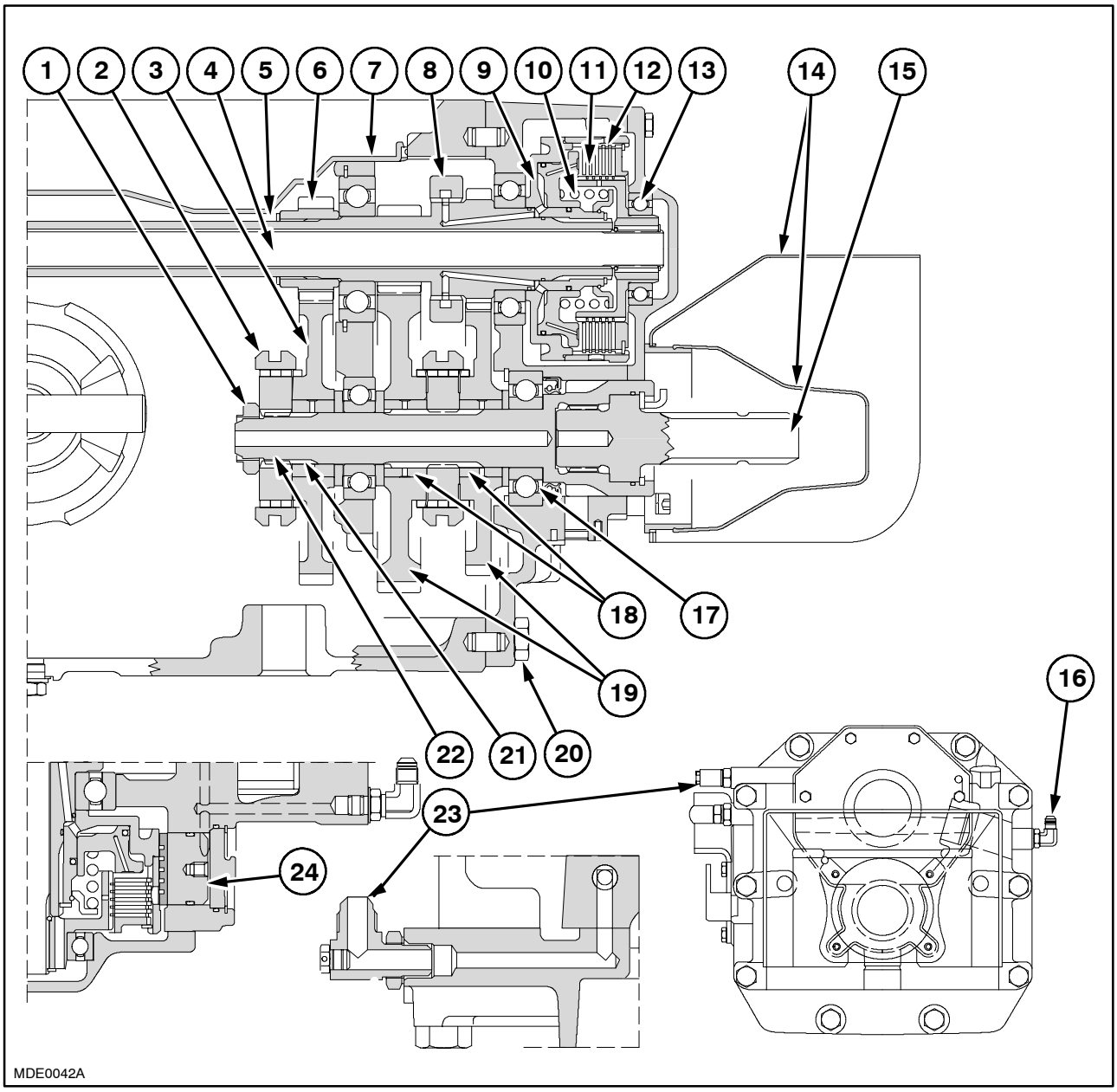
26328



2

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Driven gear shaft locknut (C_1)	M 28 x 1.5	294	30
Clutch cover retaining bolts (C_2)	M 8	25	2,6
PTO guard retaining bolts (C_3)	M 8	25	2,6
PTO housing retaining bolts (C_4)	M 16 x 1.5	221	22,5
Retaining bolts for speed selection cable sheath bracket (C_5)	M 10 x 1.25	55	5,6
Rear bearing support retaining bolts (C_6)	M 12 x 1.25	98	10

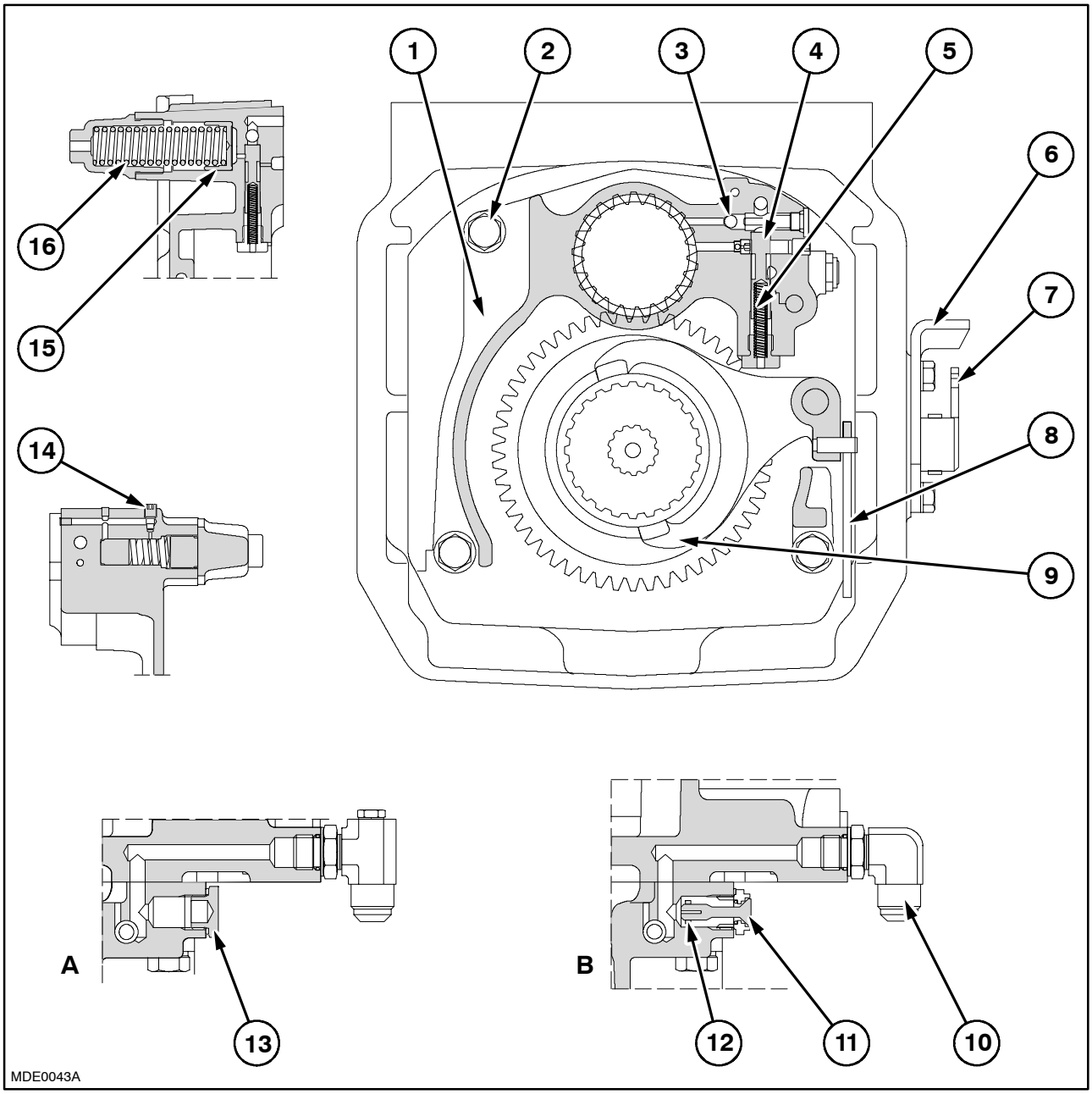


3

Cross-sectional views of the 540 - 750 - 1000 rpm PTO (on request)

1. Driven shaft lock nut.
2. 750 rpm PTO coupling sleeve.
3. 750 rpm rear driven gear.
4. Flywheel drive shaft.
5. Gearbox drive shaft.
6. Drive shaft gear unit.
7. Rear bearing support.
8. Oil delivery manifold on hydraulic cylinder (9).
9. Clutch engagement hydraulic cylinder (drive from flywheel).
10. Clutch disk disengagement spring (11 and 12).
11. Clutch driving disk.
12. Clutch driven disk.
13. Clutch rear bearing.
14. Shaft guards (15).
15. PTO grooved terminal.
16. Delivery/return line to brake (24).
17. Seal.
18. Driven gear front and central bushings (19).
19. Front (1000 rpm) and central (540 rpm) driven gears.
20. PTO unit retaining bolt.
21. Driven gear rear bushing (3).
22. Driven shaft.
23. PTO clutch cylinder (9) delivery/exhaust line.
24. Clutch brake cylinder.

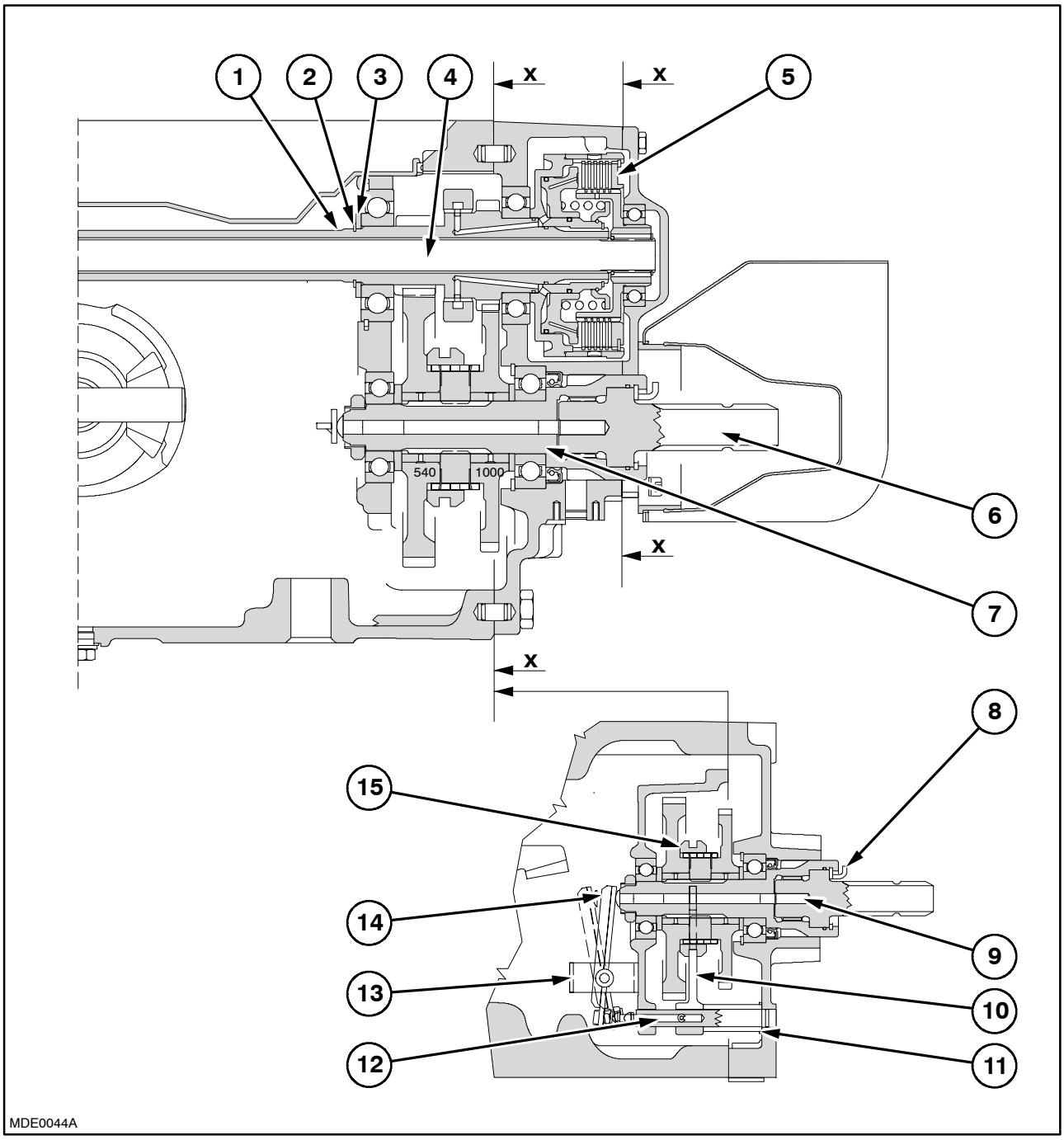
NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *following the instructions and diagrams on page 30.*



4

Cross-sectional views of the 540 - 750 - 1000 rpm PTO (on request)

A. Version with Power Shuttle.
B. Version without Power Shuttle.
1. Rear bearing support.
2. Support retaining bolts.
3. Cylinder oil discharge valve (9, fig. 3).
4. Lubrication valve (bearings and clutches).
5. Spring for valve (4).
6. PTO speed selection cable sheath bracket.
7. PTO selection external lever.
8. PTO selection internal device.
9. Speed selection control fork.
10. Lubrication delivery union.
11. Lubrication pressure relief valve.
12. Spring for valve (11).
13. Plug.
14. Choke for gradual PTO engagement.
15. Accumulator cylinder.
16. Accumulator spring for gradual PTO engagement.

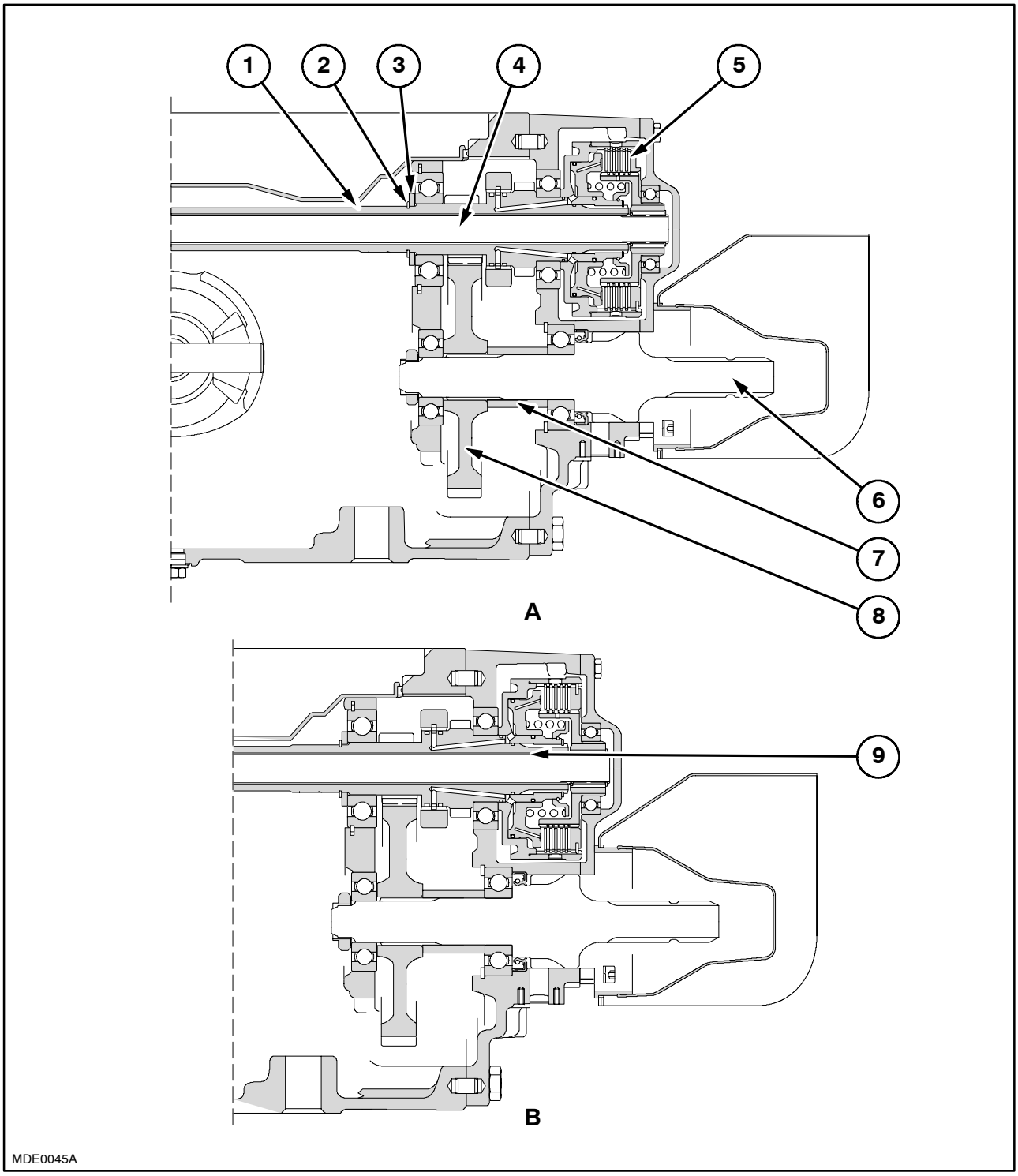


5

Cross-sectional views of 540 - 1000 rpm PTO NASO version (on request) not synchronized with the gearbox with the grooved terminal gearbox speed selection device

1. Shaft with driving gears.
2. Retaining snap ring (3).
3. Bearing thrust ring.
4. Flywheel drive shaft.
5. Drive engagement clutch commanded by shaft (4).
6. Grooved terminal 1 $^{3}/_{8}$" (6 grooves) for 540 rpm PTO or 1 $^{3}/_{8}$" (21 grooves) for 1000 rpm PTO.
7. Driven shaft.
8. Retaining snap ring (6).
9. Speed selection pin.
10. Speed selection sleeve control fork.
11. Return spring.
12. Return pin.
13. Speed selection support lever.
14. Speed selection lever.
15. Speed selection sleeve.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *following the instructions and diagrams on page 30.*

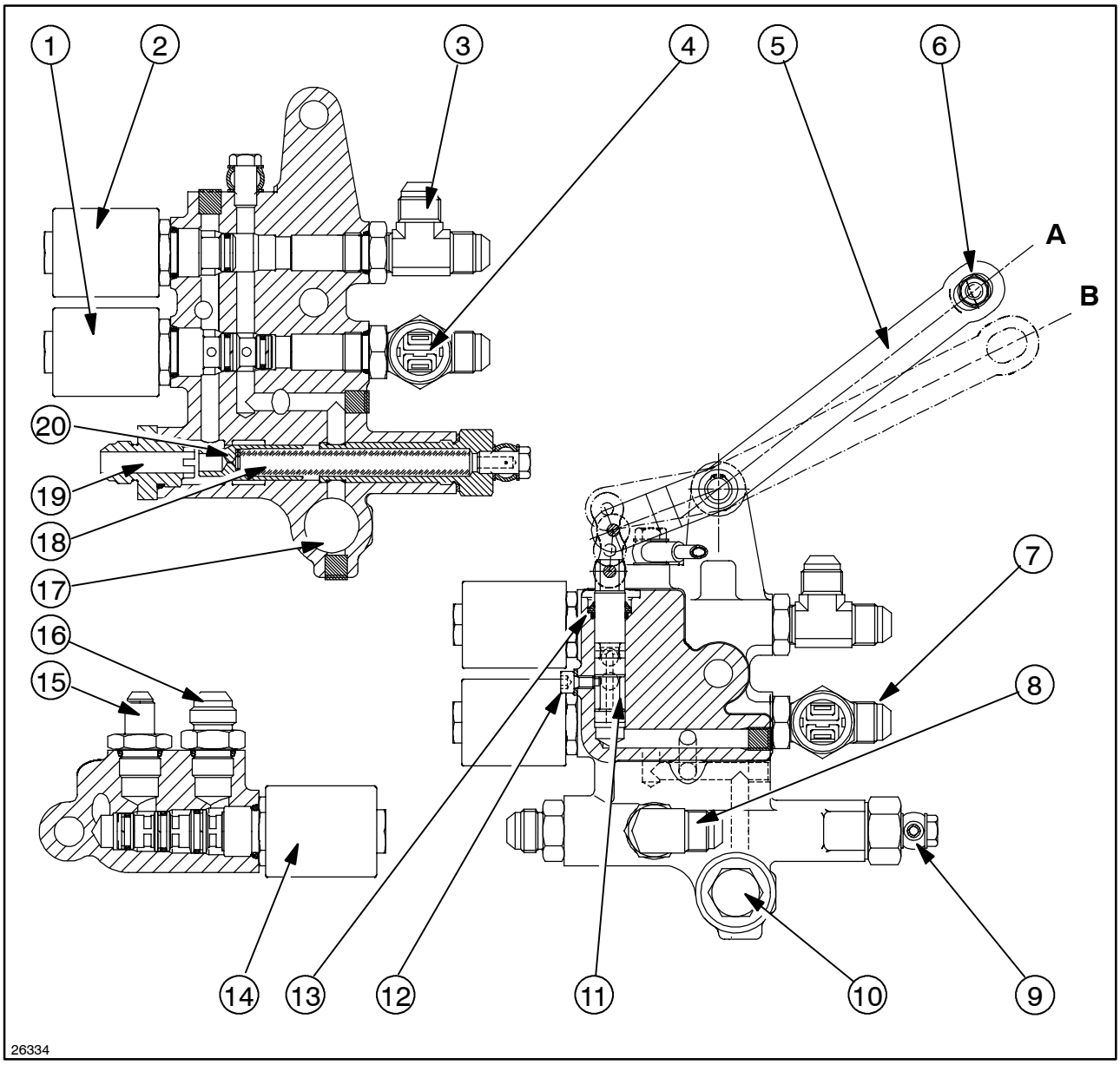


6

Longitudinal sectional diagram of 540 rpm PTO.

A. Cross-sectional view of standard PTO (for model TL100) governed by the flywheel or synchronized with the gearbox.
B. Sectional diagram of non-synchronized PTO.
1. Gearbox drive shaft.
2. Retaining snap ring.
3. Bearing thrust ring.
4. Flywheel drive shaft.
5. Drive engagement clutch commanded by shaft (4).
6. PTO grooved terminal.
7. Spacer.
8. Driven gear.
9. Shaft with driving gears.

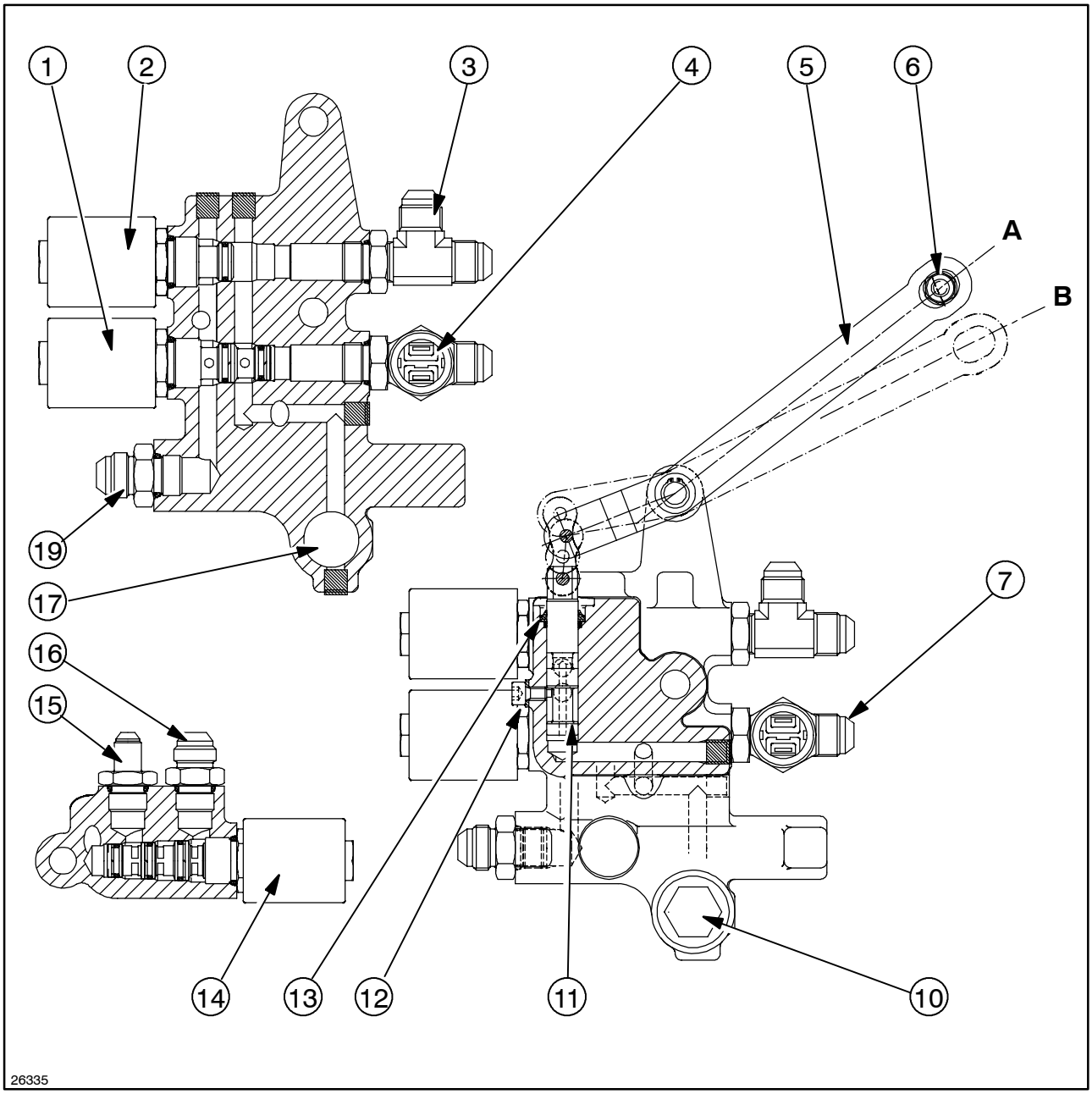
NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *following the instructions and diagrams on page 30.*



7

Sectional views of the services control valve with solenoid valves [tractor without Dual Command (2 Speed Power Shift)]

A. Lever position with PTO synchronized with gearbox engaged.
B. Lever position with hydraulic PTO commanded by flywheel engaged.
1. 4WD disengagement solenoid valve.
2. Front or rear differential lock engagement solenoid valve.
3. Front or rear differential lock delivery union.
4. 4WD engagement line pressure gauge.
5. Oil flow cut-off lever to solenoid valve (14), flywheel PTO clutch engagement, when engaged the PTO is synchronized with gearbox.
6. Cam to adjust valve stroke (11).
7. 4WD engagement delivery union.
8. PTO clutch rear bearing lubrication delivery union.
9. Pressure relief valve-outlet connecting union.
10. External plug on outlet line.
11. Oil delivery to solenoid valve (14) control valve rod.
12. Bolt retaining valve (11).
13. Valve seal and dust seal (11).
14. Oil delivery solenoid valve to PTO clutch or clutch brake.
15. Clutch brake delivery union.
16. PTO clutch engagement cylinder delivery union.
17. Outlet line to transmission casing.
18. Pressure relief valve spring.
19. Solenoid valve support delivery union.
20. Pressure relief valve.



8

Sectional views of the services control valve with solenoid valves [tractor with Dual Command (2 Speed Power Shift)]

A. Lever position with PTO synchronized with gearbox engaged.

B. Lever position with electrohydraulic PTO commanded by flywheel engaged.

1. 4WD disengagement solenoid valve.

2. Front or rear differential lock engagement solenoid valve.

3. Front or rear differential lock delivery union.

4. 4WD engagement line pressure gauge.

5. Oil flow cut-off lever to solenoid valve (14), flywheel PTO clutch engagement, when engaged the PTO is synchronized with gearbox.

6. Cam to adjust valve stroke (11).

7. 4WD engagement delivery union.

10 External plug on outlet line.

11 Oil delivery to solenoid valve (14) control valve rod.

12 Bolt retaining valve (11).

13 Valve seal and dust seal (11).

14 Solenoid valve for oil flow to PTO clutch or clutch brake.

15 Clutch brake delivery union.

16 PTO clutch engagement cylinder delivery union.

17 Outlet line to transmission casing.

19 Solenoid valve support delivery union.

DESCRIPTION AND OPERATION OF ELECTROHYDRAULIC PTO

The PTO installed on the tractor transfers motion to the transported or towed implements. It can be controlled:

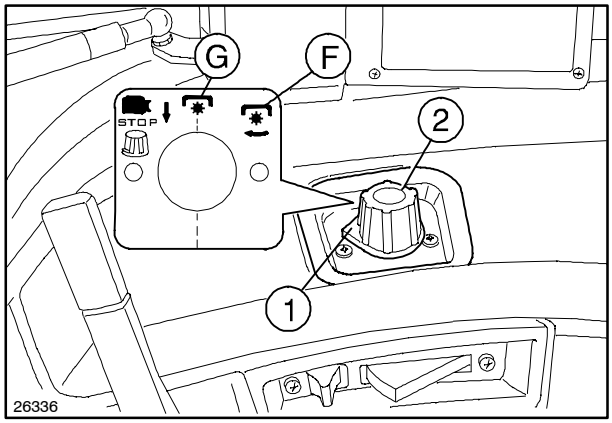
a) directly by the flywheel;

b) synchronized with the gearbox.

The electrohydraulically engaged/disengaged PTO is available in three versions.

The description and operation is of the most complete PTO, i.e.: the 540 - 750 - 1000, for the other two versions see page 19.

The controls are located inside the cab on the right-hand side to the rear of the driving position.

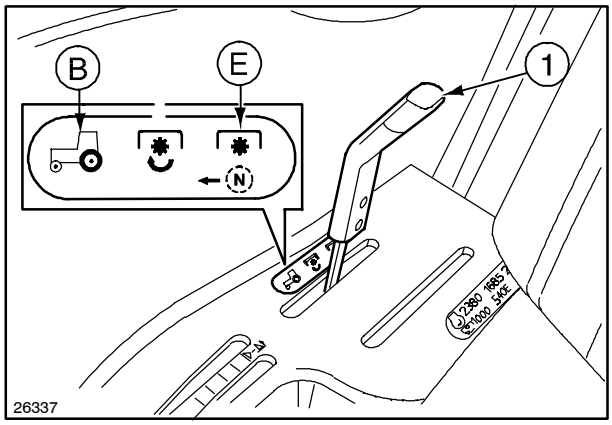


9

a) PTO Independent electro-hydraulically controlled power take-off (directly by flywheel)

To engage, proceed a follows:

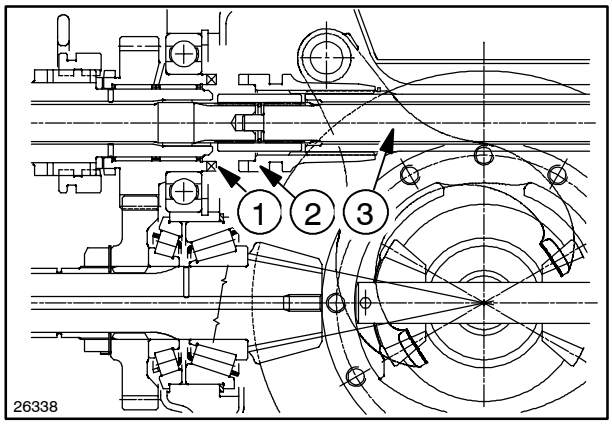
1. Check that the pointer (1, fig. 9) is in position G, equivalent to the oil delivery solenoid valve (1, fig. 12) de-energized.



10

2. Move the PTO operation selection lever (1, fig. 10) onto (E).

   In this position the sleeve (2, fig. 11) is freed from the toothed coupling of the gearbox gear (1), so only the PTO connected to the flywheel via the shaft (3) can work.



11

Moving the lever (1, fig. 10) onto (E) acts, via the control levers, also on the rod of the control valve (4, fig. 12), which takes on the above-mentioned position.

With the rod (4) in this position and the solenoid valve (1) deactivated, the control valve hydraulic diagram is as shown in fig. 12.

The line (11) receives pressurized oil from the pump and the control valve (4) directs the pressurized oil to the solenoid control valve (1).

With the solenoid valve (1) deactivated, the delivery line to the PTO clutch engagement cylinder (2) discharges and is connected to line (10), whereas the delivery line to the clutch brake (3) remains pressurized.

Under these conditions the PTO clutch is disengaged and the clutch brake is engaged.

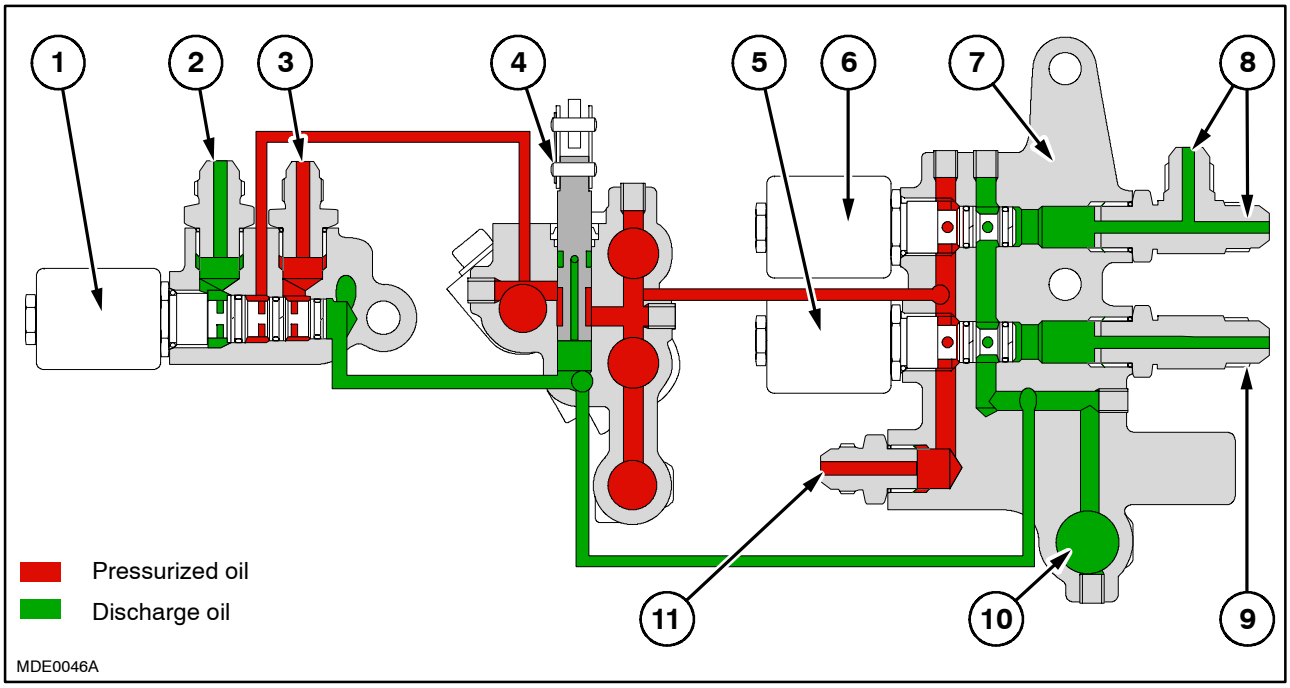
The hydraulic diagram shown in fig. 20, illustrates this phase. In this phase the delivery line (7, fig. 20) is discharged, so the lubrication control valve (8), takes on the position shown in fig. 20 permitting lubrication of just the rear bearing of the clutch (3).

The pressurized oil from line (11, fig. 12) can also be used for the services on lines (8) and (9).

The figure shows solenoid valves (5) and (6) deactivated.

With solenoid valve (5) deactivated, the delivery line (9) discharges and the 4WD engages.

With solenoid valve (6) deactivated the delivery line (8) discharges, with the relative disengagement of the front and rear differential lock.

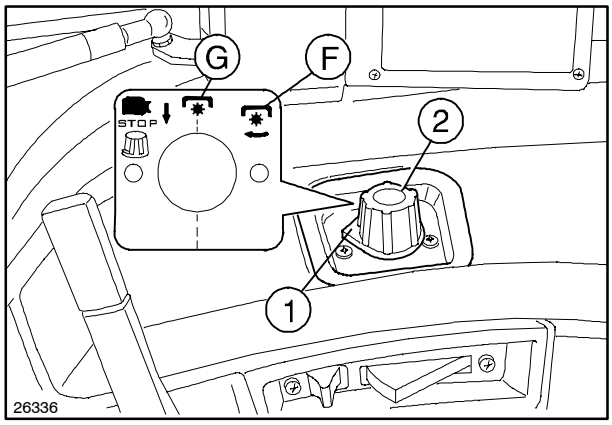


12

Service control valve hydraulic diagram (points 1-2 page 13)

1. Oil delivery solenoid valve to PTO clutch or clutch brake (deactivated).
2. Delivery line (discharging) to the PTO clutch engagement cylinder.
3. Delivery line (pressurized) to the clutch brake.
4. Control valve rod position (4) when the lever (1, fig. 10) is in position E.
5. 4WD disengagement solenoid valve.
6. Front or rear differential engagement solenoid valve.
7. Control valve support.
8. Delivery lines discharging (front and rear differential disengaged).
9. Delivery line discharging (4WD engaged).
10. Outlet line to transmission casing.
11. Delivery line from the pump to the services control valve (7).

3. After having carried out operation (2, page 13), fully press down knob (2, fig. 13), take the pointer (1) onto (F), equivalent to solenoid valve (1, fig. 15) energized.
   This transfers movement from the flywheel, via shaft (12, fig. 21) and clutch (3), to the PTO grooved terminal.



13

For the hydraulic operation derived from operations 2 and 3, see the description on page 16.

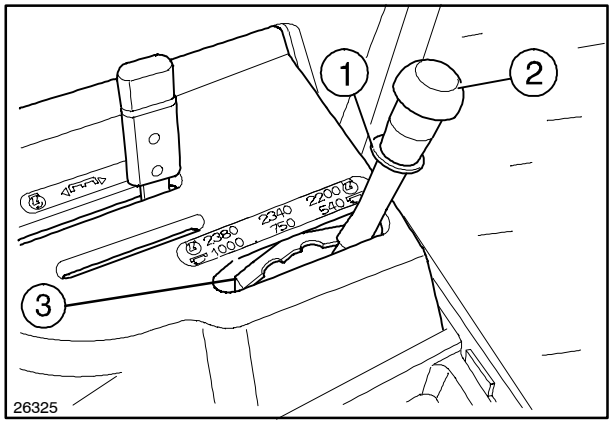
With operations 2 and 3 (previously described) the independent PTO is electrohydraulically engaged and directly controlled from the flywheel.

Power take-off speed selection lever

Proceed as follows.

1. Press knob (2, fig. 13) moving the pointer (1) onto (G) in order to disengage the clutch (3, fig. 21) of the power take-off.

2. Pull the stop knob (1, fig. 14) upwards and move the lever (2) onto sector (3) on the selected speed; this operation acts on parts (7 and 8, fig. 4) and on the speed engagement sleeve forks (9).



14

3. Press knob (2, fig. 13) fully down and move the pointer (1) to position (F) to re-engage the PTO clutch.

DESCRIPTION AND OPERATION

With lever (1, fig. 10) on E and solenoid valve (1, fig. 15) energized, the hydraulic diagram of the control valve is the one shown in the figure 15.

The line (11) receives pressurized oil from the pump and the control valve (4) directs the pressurized oil to the solenoid control valve (1).

With the solenoid valve (1) activated, the delivery line to the PTO clutch engagement cylinder (2) is pressurized, whilst the delivery line to clutch brake (3) discharges and is connected to line (10).

The PTO clutch is therefore engaged and the clutch brake is disengaged.

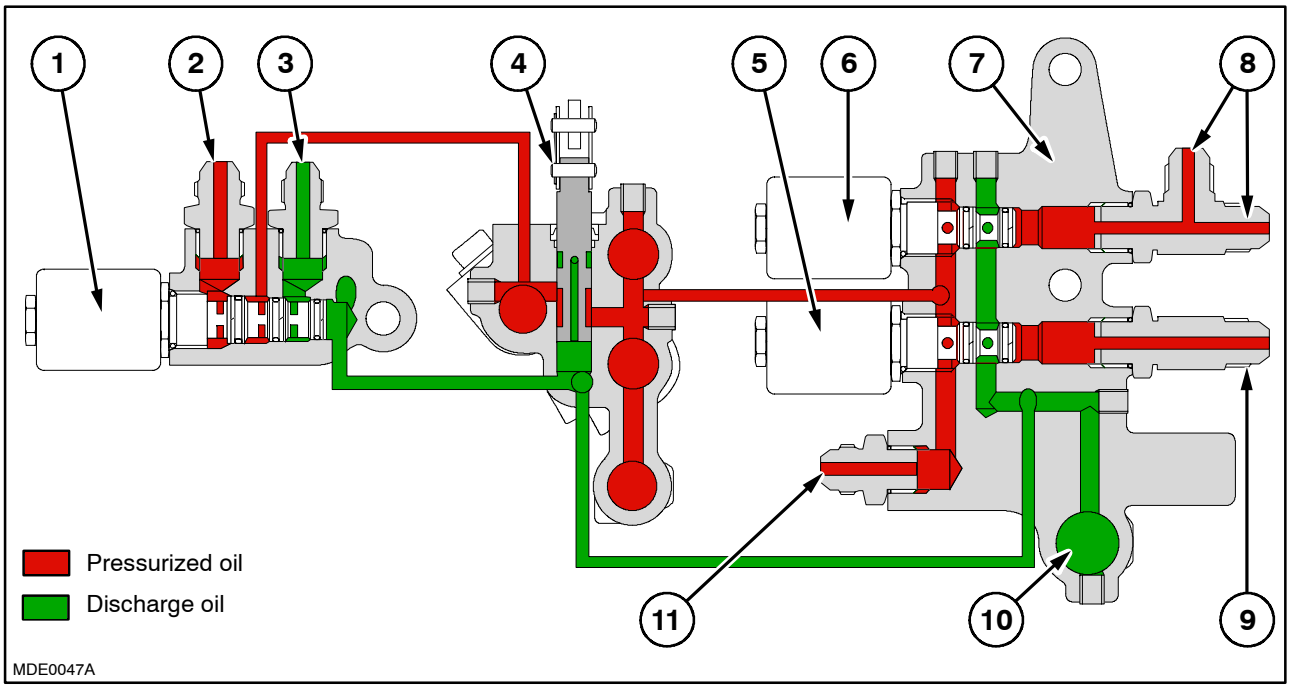
The hydraulic diagram shown in fig. 21, illustrates this phase. In this phase the delivery line (7, fig. 21) is pressurized, so the lubrication control valve (8), takes on the position shown in the figure, permitting lubrication of the clutch front/rear bearings and the clutch.

The pressurized oil from line (11, fig. 15) can also be used for the services on lines (8) and (9).

The figure shows solenoid valve (5) and (6) activated.

With the solenoid valve (5) activated, the delivery line (9) is pressurized and 4WD is disengaged.

With the solenoid valve (6) activated, the delivery line (8) is pressurized and the front and rear differential lock is engaged.



15

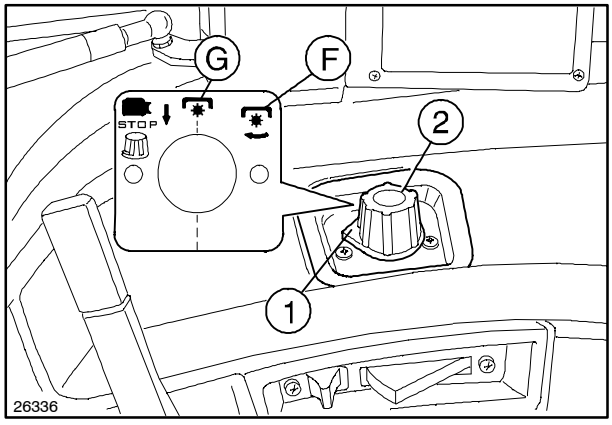
Services control valve hydraulic diagram (points 2 and 3 pages 13 and 15)

1. Oil delivery solenoid valve to PTO clutch or clutch brake (energized).
2. Delivery line (pressurized) to the PTO clutch engagement cylinder.
3. Delivery line (discharging) to the clutch brake.
4. Position of the control valve rod (4, fig. 15) when the lever (1, fig. 10) is in position A.
5. 4WD disengagement solenoid valve.
6. Front or rear differential engagement solenoid valve.
7. Control valve support.
8. Pressurized delivery lines (front and rear differential engaged).
9. Delivery line pressurized (4WD disengaged).
10. Outlet line to transmission casing.
11. Delivery line from the pump to the services control valve (7).

b) PTO synchronized to gearbox

To engage, proceed as follows:

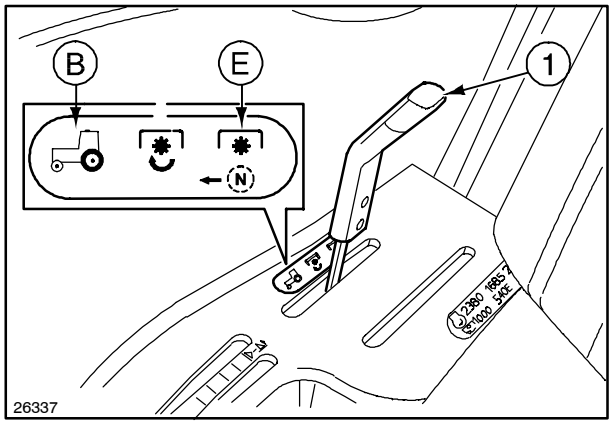
1. Check that the pointer (1, fig. 16) is on G, equivalent to solenoid valve (1, fig. 12) de-energized.



16

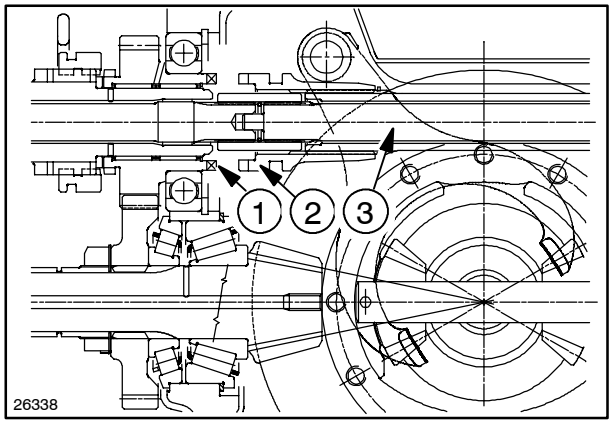
2. Press the gearbox engine clutch control pedal (1, fig. 17) fully down onto (B) and release the pedal.

   This activates levers on the control valve rod (4), as indicated in fig. 19 positioning it in relation to the PTO synchronized with gearbox.



17

NOTE: *At the same time, move the PTO operation selection lever (1, fig. 17) to position (B), engaging sleeve (2, fig. 18) on the gearbox gearing teeth (1) (PTO synchronized with gearbox).*
The hydraulic diagram in fig. 19 and the relative description show the operation of the services control valve when the control valve rod (4) is in position in relation to the PTO synchronized with gearbox.



18

DESCRIPTION AND OPERATION WITH ROD (4) IN THE PTO SYNCHRONIZED WITH GEARBOX POSITION

When the PTO is synchronized with the gearbox (as indicated in points 1-2, page 17), the rod of the control valve (4) is in the position shown in figure 19.

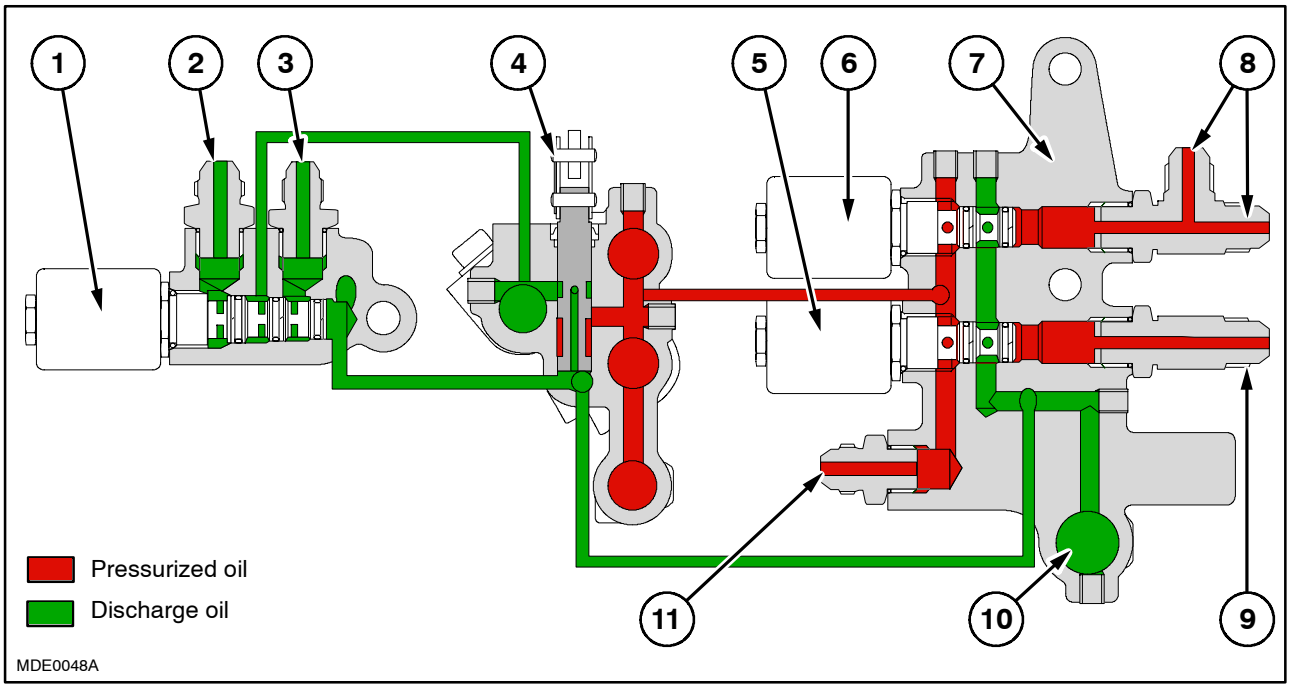
The line (11) receives pressurized oil from the pump, but the control valve (4) closes the oil flow to the PTO clutch (2) engagement cylinder delivery lines and to the PTO clutch brake (3), connecting to the discharge line (10) to the transmission casing, as shown in the drawing.

The pressurized oil from line (11) can be used for the services on lines (8) and (9).

The figure shows solenoid valve (5) and (6) activated.

With the solenoid valve (5) activated, the delivery line (9) is pressurized and 4WD is disengaged.

With the solenoid valve (6) activated, the delivery line (8) is pressurized and the front and rear differential lock is engaged.



19

Services control valve with rod (4) in PTO synchronized with gearbox position hydraulic diagram

1. Oil delivery solenoid valve to PTO clutch or clutch brake (deactivated).
2. Delivery line (discharging) to the PTO clutch engagement cylinder.
3. Delivery line (discharging) to the clutch brake.
4. Control valve rod oil delivery to solenoid valve (1) in PTO synchronized with gearbox position.
5. 4WD disengagement command solenoid valve activated.
6. Front or rear differential engagement command solenoid valve activated.
7. Control valve support.
8. Pressurized delivery lines (front and rear differential engaged).
9. Delivery line pressurized (4WD disengaged).
10. Outlet line to transmission casing.
11. Delivery line from the pump to the services control valve (7).

DESCRIPTION AND OPERATION OF 540-1000 RPM ELECTROHYDRAULIC PTO "NASO" VERSION

(optional for all models, see page 9).

As opposed to the PTO previously described, the 540-1000 rpm PTO cannot be synchronized with the gearbox, as the shaft (1, fig. 5) is not connected.

This version can only be driven by the flywheel via shaft (4) and clutch (5).

With regard to the description, operation and hydraulic diagrams, see 540-750-1000 PTO with electrohydraulic engagement (directly controlled by the flywheel) described in point (**a**, pages 13 to 16), bearing in mind that in this case the speed is selected when the grooved terminal is changed.

On changing the grooved terminal (6, fig. 5) 1 $^{3}/_{8}$" with 6 grooves (for 540 rpm PTO), or 1 $^{3}/_{8}$" with 21 grooves (for 1000 rpm PTO), the pin (9) acts on an internal lever mechanism which engages the PTO speed selection engagement sleeve (15) by means of the fork (10).

DESCRIPTION AND OPERATION OF 540 RPM PTO WITH ELECTROHYDRAULIC ENGAGEMENT

This version can be provided with two alternative solutions.

Solution (A, fig. 6), standard for model TL100 and optional for all other models.

The first solution can be driven by the flywheel via the shaft (4) and clutch (5), or by the gearbox via shaft (1).

In this case the PTO shaft is synchronized with the gearbox and the clutch (5) remains disengaged.

With regard to the description, operation and hydraulic diagrams, see 540-750-1000 PTO with electrohydraulic engagement described in points (**a**, pages 13 to 16) and (**b**, pages 17 and 18), bearing in mind that, with this version, the speed cannot be selected by means of the lever described on page 15.

Solution (B, fig. 6), optional for all models

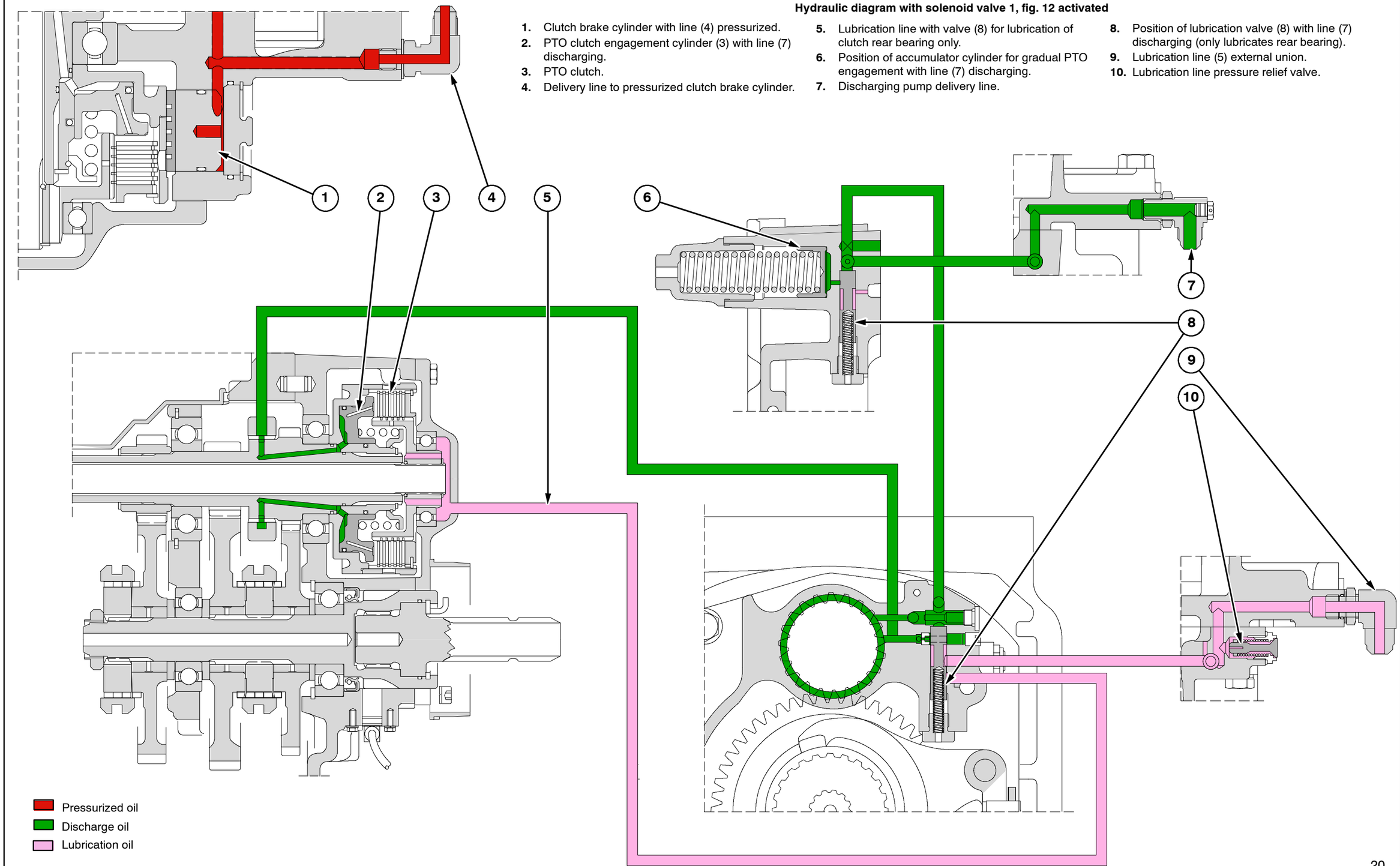
As opposed to the PTO previously described, this second solution cannot be synchronized with the gearbox, as the shaft (9, fig. 6) is not connected.

This version can only be driven by the flywheel via shaft (4) and clutch (5).

With regard to the description, operation and hydraulic diagrams, see 540-750-1000 PTO with electrohydraulic engagement (directly controlled by the flywheel) described in point (a) pages 13 to 16, bearing in mind that, with this version, the speed cannot be selected by means of the lever described on page 15.

Hydraulic diagram with solenoid valve 1, fig. 12 activated

1. Clutch brake cylinder with line (4) pressurized.
2. PTO clutch engagement cylinder (3) with line (7) discharging.
3. PTO clutch.
4. Delivery line to pressurized clutch brake cylinder.
5. Lubrication line with valve (8) for lubrication of clutch rear bearing only.
6. Position of accumulator cylinder for gradual PTO engagement with line (7) discharging.
7. Discharging pump delivery line.
8. Position of lubrication valve (8) with line (7) discharging (only lubricates rear bearing).
9. Lubrication line (5) external union.
10. Lubrication line pressure relief valve.

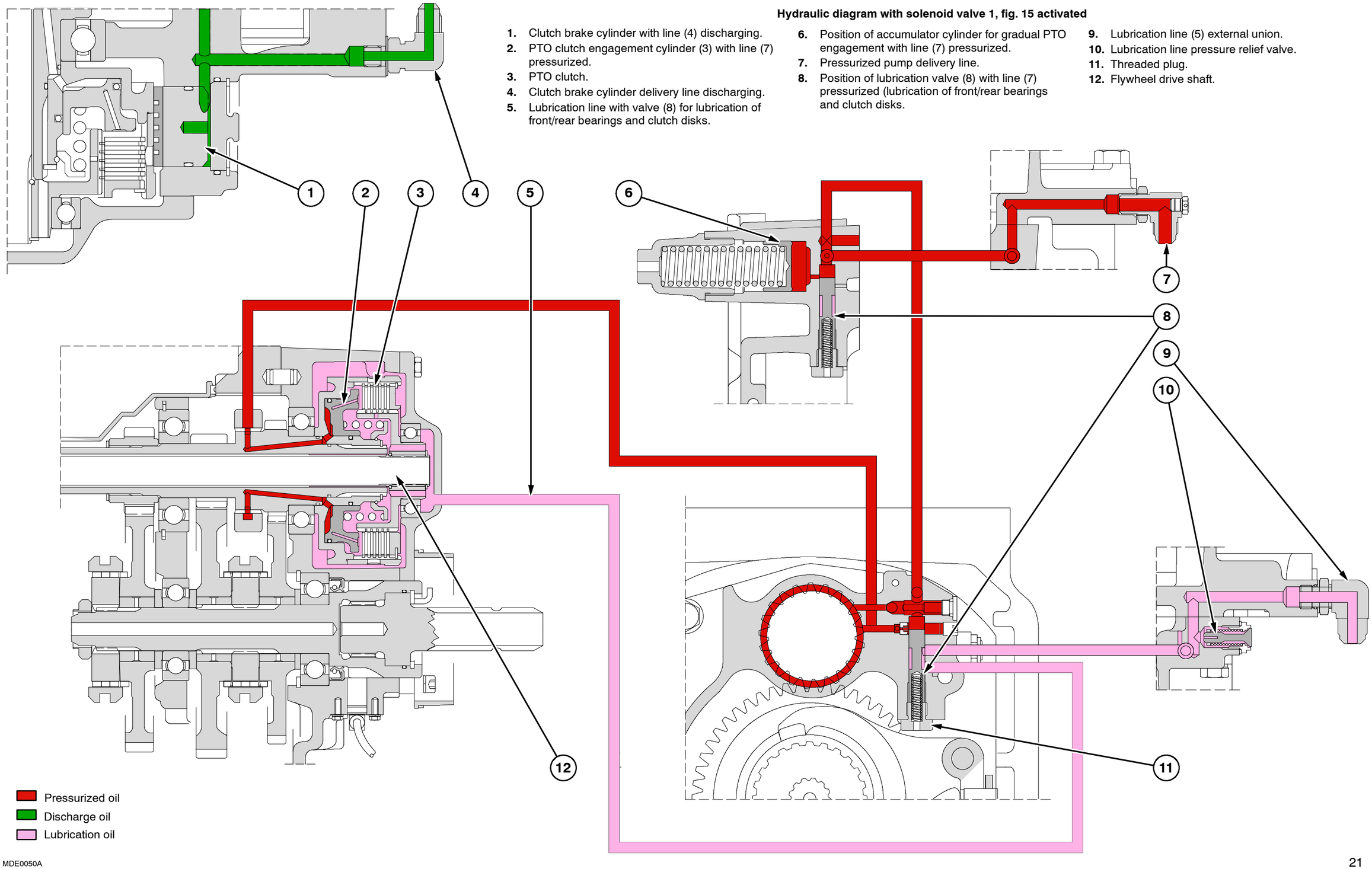


MDE0049A

20

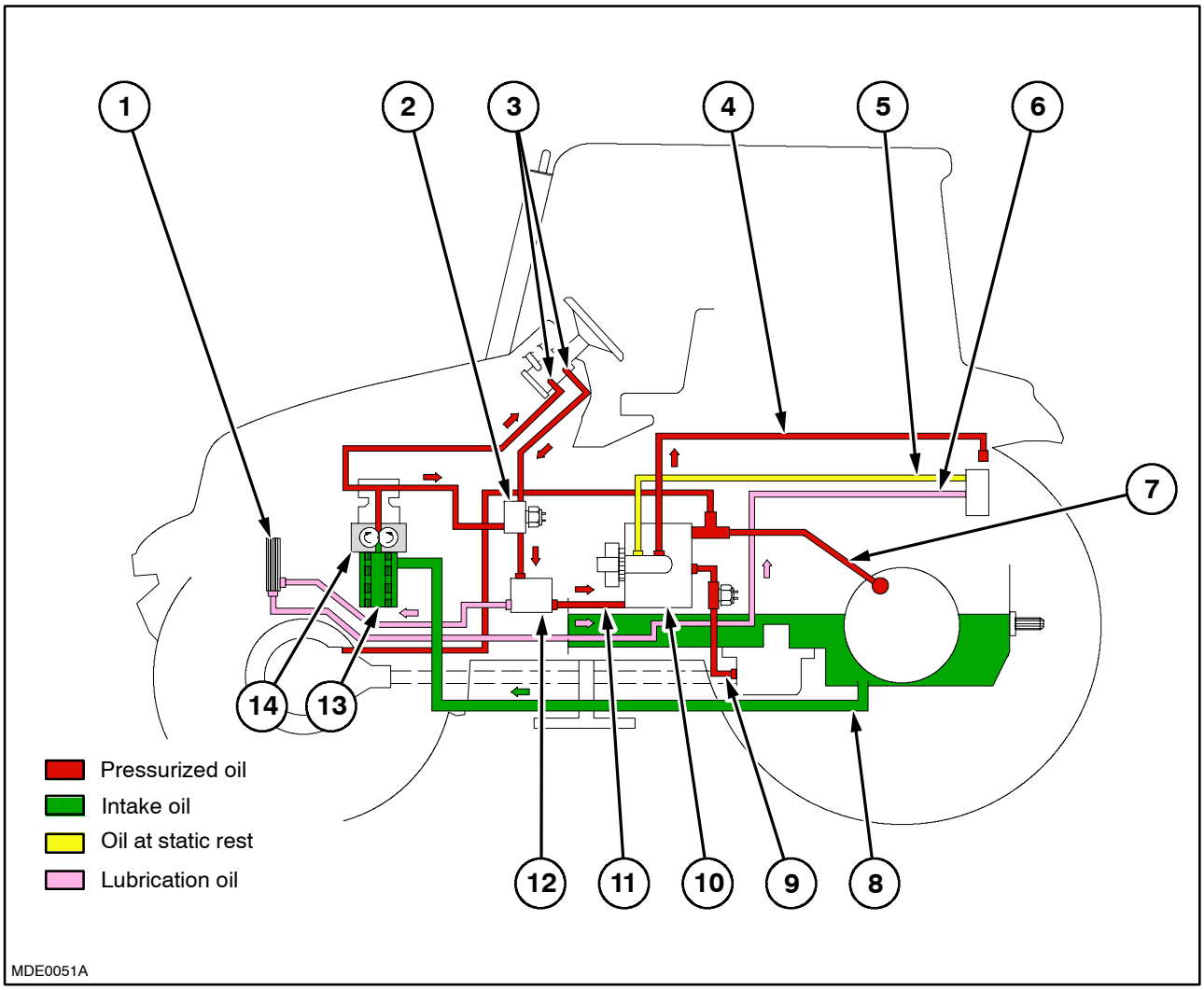
Hydraulic diagram with solenoid valve 1, fig. 15 activated

1. Clutch brake cylinder with line (4) discharging.
2. PTO clutch engagement cylinder (3) with line (7) pressurized.
3. PTO clutch.
4. Clutch brake cylinder delivery line discharging.
5. Lubrication line with valve (8) for lubrication of front/rear bearings and clutch disks.
6. Position of accumulator cylinder for gradual PTO engagement with line (7) pressurized.
7. Pressurized pump delivery line.
8. Position of lubrication valve (8) with line (7) pressurized (lubrication of front/rear bearings and clutch disks.
9. Lubrication line (5) external union.
10. Lubrication line pressure relief valve.
11. Threaded plug.
12. Flywheel drive shaft.



MDE0050A

21



22

Tractor hydraulic diagram

1. Heat exchanger for rear transmission gearbox oil cooling.
2. Power steering anti-cavitation tank.
3. Power steering lines.
4. Clutch brake cylinder control line.
5. PTO clutch engagement cylinder control line.
6. Bearings and PTO clutch lubrication line.
7. Front and rear differential lock engagement lines.
8. Transmission oil intake line.
9. 4WD engagement control line.
10. Services control valve (brake and PTO clutch, front and rear differential lock control, 4WD engagement control).
11. Delivery line from control valve (12) to control valve (10).
12. Dual Command (2 Speed Power Shift) control valve.
13. Oil filter.
14. Hydraulic pump.

Description of operation - Hydraulic system

The hydraulic system (see fig. 22) functions as follows;
The pump (14) sucks oil from the rear transmission through line (8), the oil is filtered through filter (13) and directed through lines (3) to the anti-cavitation tank (2) and Power steering. After having served the power steering, the excess oil is directed to control valve (12) on the Dual Command (2 Speed Power Shift), and from here to the services control valve (10) and heat exchanger (1) in order to lower the temperature. The services control valve (10) (operation described on pages 14, 16, 18 makes it possible:

- via pipe (4) to govern the clutch brake cylinder;
- via pipe (5) to govern the PTO clutch engagement cylinder;
- via pipe (6) to lubricate the clutch bearings and the PTO engagement clutch;
- via pipes (7) to control the front and rear differential lock engagement.

PTO TROUBLESHOOTING

Problems	Possible Causes	Solutions
The independent PTO (governed by the flywheel) fails to work.	1. Transmission oil level insufficient.	Top up oil level.
	2. Clogged oil filter.	Replace filter.
	3. Hydraulic pump faulty.	Overhaul or replace pump.
	4. PTO engagement switch faulty.	Replace switch.
	5. No power to solenoid valve: connections disconnected, damaged or contactor faulty.	Check electrical connections and replace defective parts.
	6. Solenoid valve (1, page 14) governing PTO clutch locked on delivery to the brake.	Overhaul or replace solenoid valve.
	7. Oil blow-by through the sealing elements with a subsequent drop in pressure: manifold seal, piston seal, etc. (see figs. 3- 4- 21).	Replace all defective seals.
The independent PTO (governed by the flywheel) stays on.	1. PTO engagement switch faulty.	Replace switch.
	2. No power to solenoid valve: connections disconnected, damaged or contactor faulty.	Check electrical connections and replace defective parts.
	3. PTO solenoid valve (1, page14) delivery blocked to clutch.	Overhaul or replace solenoid valve.
The PTO clutch drags.	1. PTO engagement switch faulty.	Replace switch.
	2. No power to solenoid valve: connections disconnected, damaged or contactor faulty.	Check electrical connections or replace defective parts.
	3. Brake solenoid valve (1, page14) delivery blocked to clutch.	Overhaul or replace solenoid valve.
	4. PTO brake (24, fig. 3) worn.	Replace the brake.

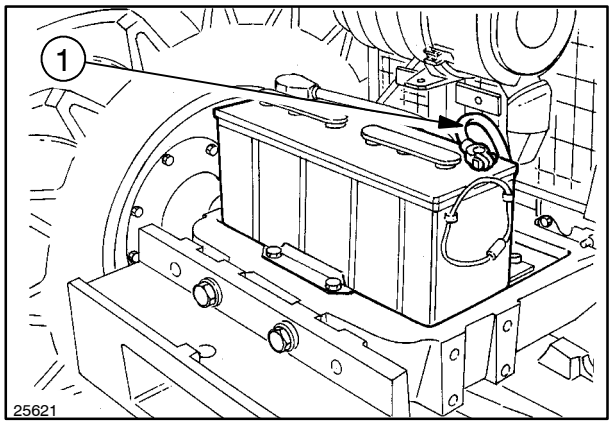
Op. 31 114 64
PTO CLUTCH BRAKE
Replacement

CAUTION

Handle all parts carefully.

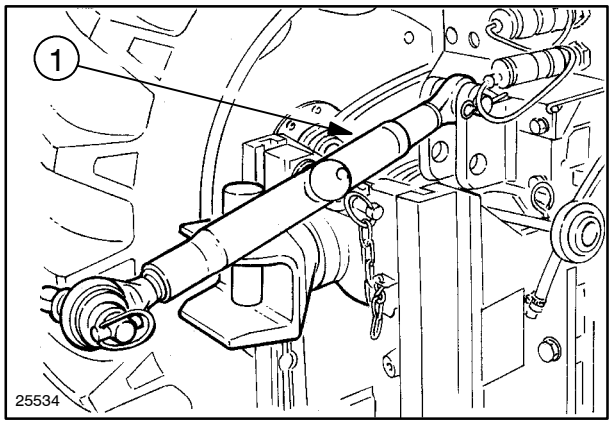
Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Disconnect the battery negative cable (1).



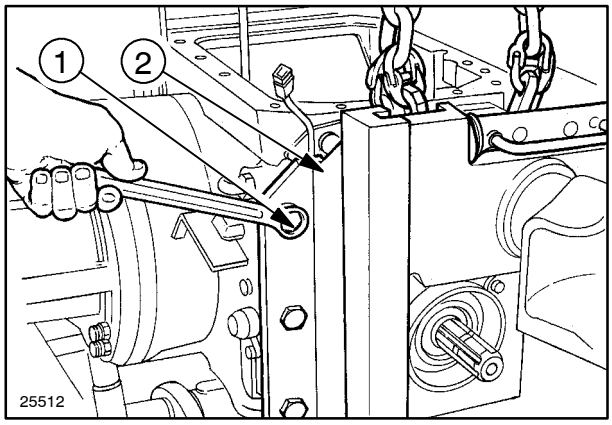
23

2. Detach the tow bar and the top link on the three-point linkage device (1).



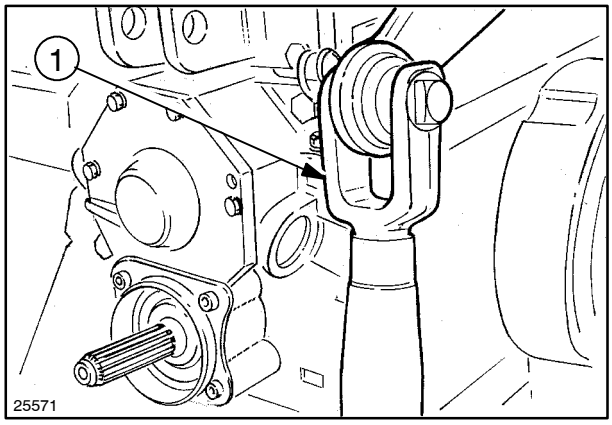
24

3. Fit a sling on the support with pick-up hitch hook (2), remove the six PTO casing retaining bolts (1) and detach the support with pick-up hitch hook.



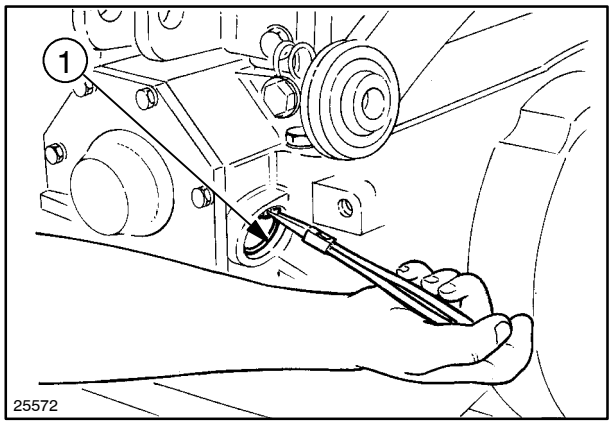
25

4. Remove the right-hand vertical tie-rod (1) from the lift arm, to have more room for subsequent disassembly.



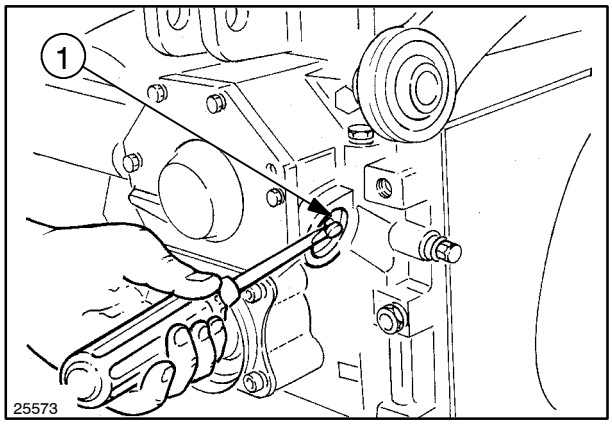
26

5. Remove the brake cover retaining snap ring (1).



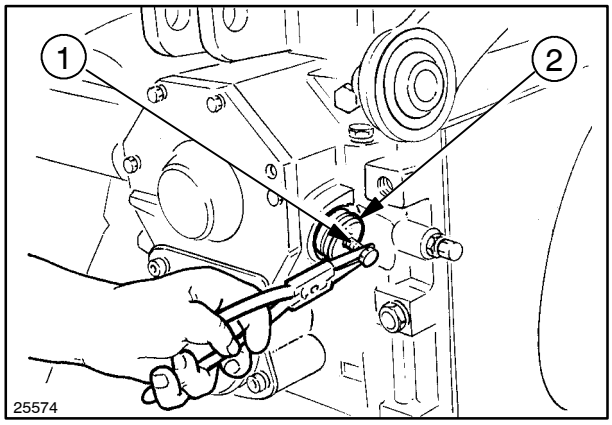
27

6. Remove the cover (1) with a screwdriver



28

7. Screw bolt (1) on the brake piston threaded hole (2) and extract the piston using pliers.



29

8. **Assembly.**

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refit the brake, the cover and insert the brake cover retaining snap ring.
- Reconnect the right-hand vertical tie-rod to the lift arm.
- Refit the pick-up hitch hook.
- Refit the tow bar and the three-point linkage device top link.
- Re-connect the battery negative lead and fit the guard on the battery.

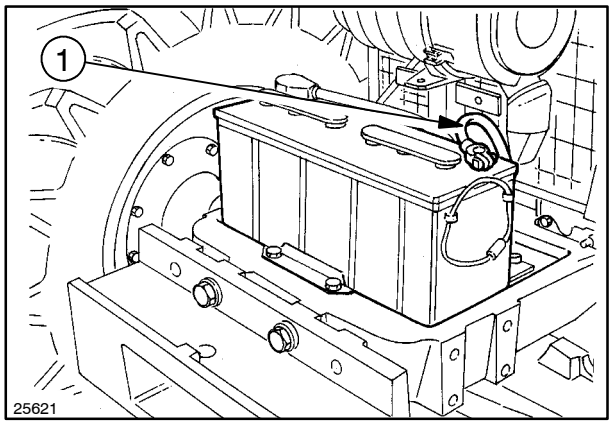
Op. 31 116 21 ELECTRO-HYDRAULIC POWER TAKE-OFF HOUSING R.I.

CAUTION

Handle all parts carefully.

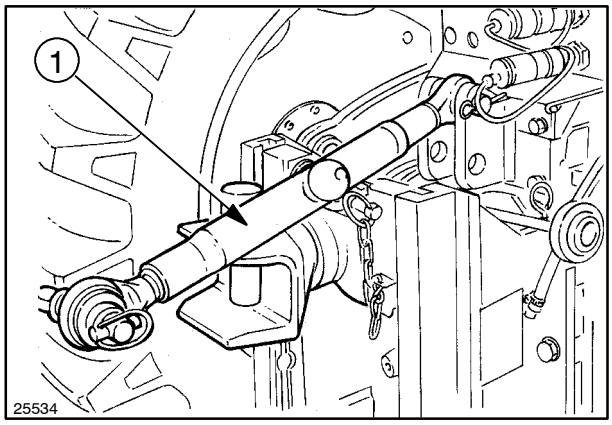
Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Disconnect the battery negative cable (1).



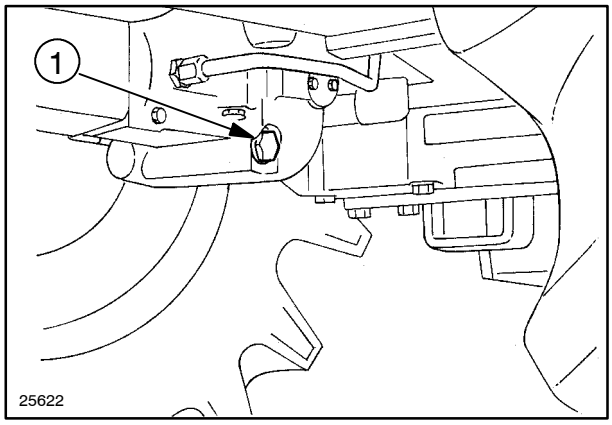
30

2. Remove the tow bar and the top link on the three-point linkage device (1).



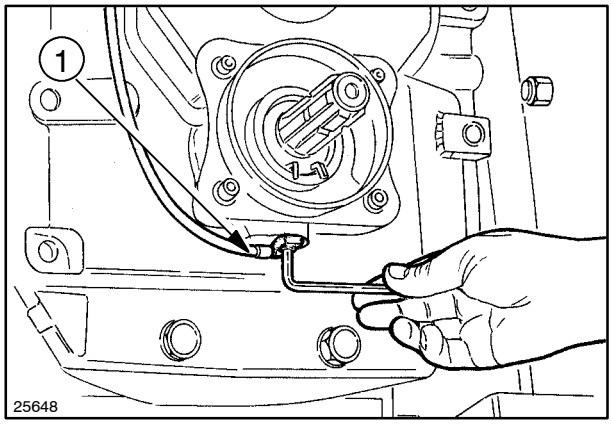
31

3. Take out the plug (1) and drain the oil from the gearbox/transmission casing.



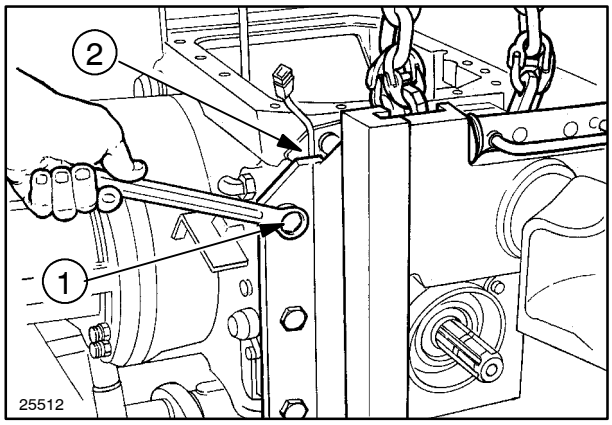
32

4. Remove the PTO speed sensor (1).



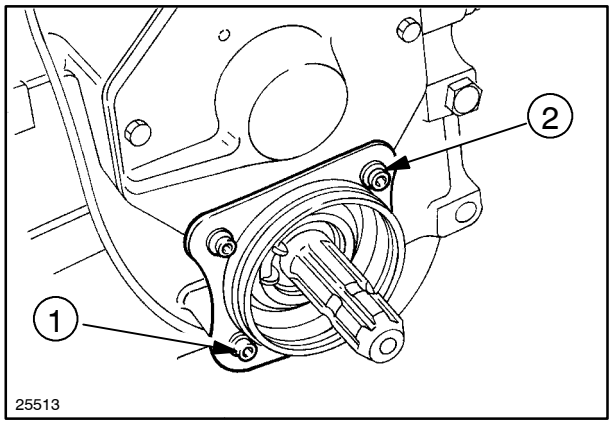
33

5. Fit a sling on the support with pick-up hitch hook (2), remove the six PTO casing retaining bolts (1) and detach the support with pick-up hitch hook.



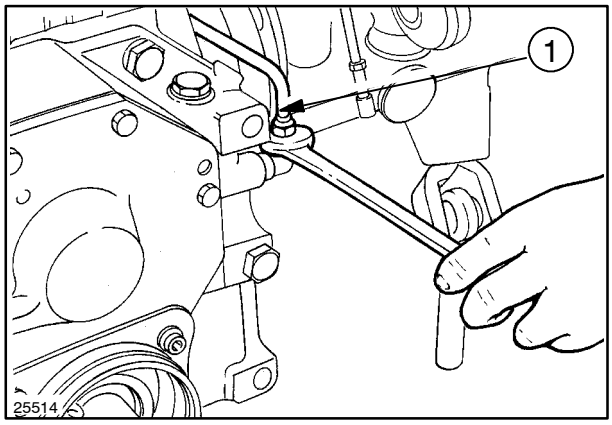
34

6. Take out the four retaining bolts (1), remove the guard (2) on the PTO terminal.



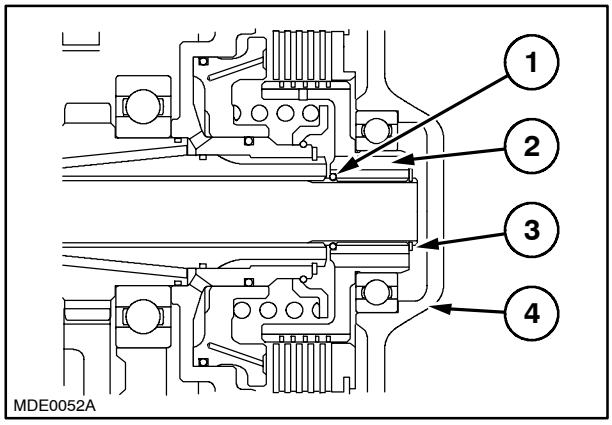
35

7. Unscrew the unions and remove the three pipes (1) from the PTO.



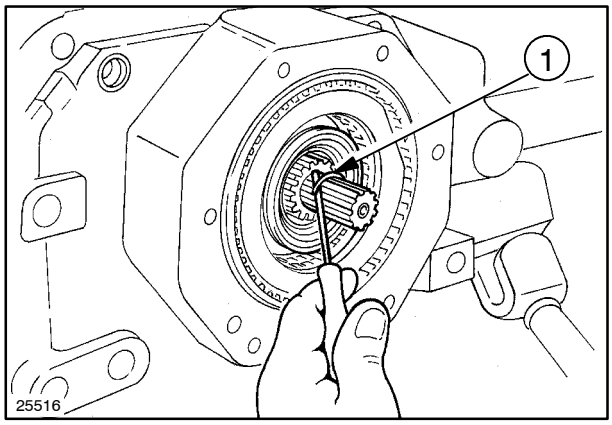
36

8. Remove the PTO cover (4), take off the front circlip (3) and the support (2) of the clutch driving disks.



37

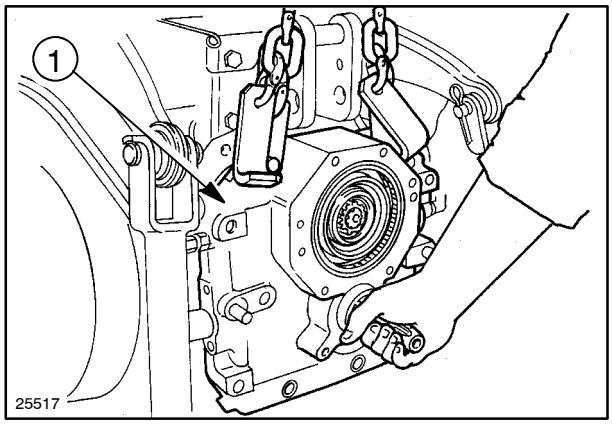
9. Remove the rear securing snap ring (1).



38

10. Hitch the PTO unit (1) to the lifting hook with chain **380000227**, and allow the hoist to take the strain, unscrew the four bolts retaining the PTO unit to the transmission/gearbox casing and remove the PTO unit.

NOTE: *Before removing the PTO unit, insert the PTO synchronized with gearbox lever, from inside the cab.*



39

CAUTION

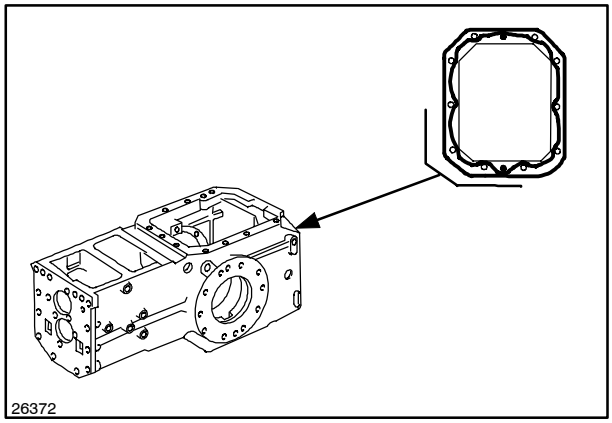
Handle all parts carefully.
Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

1. To reassemble the PTO unit, proceed as follows:

CAUTION

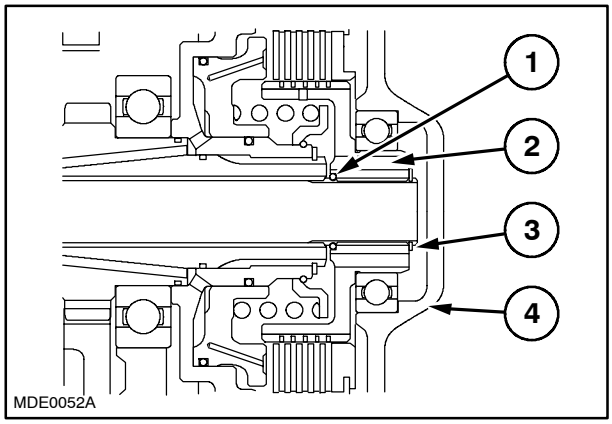
Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Clean the rear contact surface between the transmission/gearbox casing and the PTO casing.
- Re-tighten the two guide pins (used for disassembly) on the PTO unit.
- Clean the surface of the PTO casing and apply a 0.0787 in. (2 mm) diameter bead of the sealing compound indicated on page 1, Section 00 along the marked line shown in the drawing 40.
- Hitch the PTO unit to hook **380000227** with the chain.
- Place the PTO unit in front of the transmission casing, use a hoist to move the parts into position and insert on the centering pins.



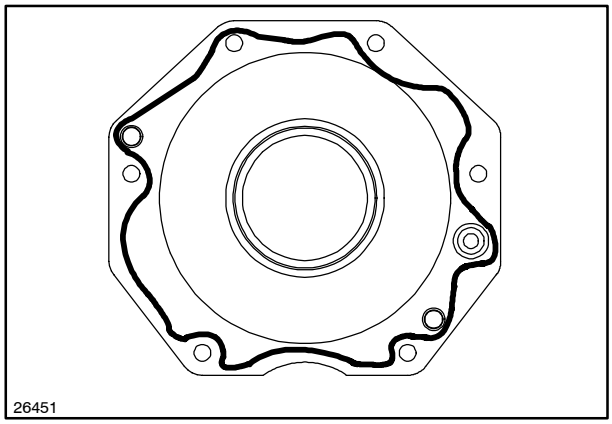
40

- Remove the chain and secure the PTO with the four screws.
- Remove the centering pins.
- Place the stop ring (1) on the grooved shaft.
- Refit the grooved support (2) on the PTO clutch and insert the retaining snap ring (3).
- Carefully clean the contact surface the PTO cover (4) and apply the sealing compound indicated on page 1, Section 00 of the diameter of 0.0787 in. (2 mm) along the marked line shown in fig. 42.
- Refit the cover (4) and the PTO terminal guard.
- Refit the PTO speed sensor and secure with two bolts.



41

- Secure the PTO speed sensor electric cable bracket.
- Refit the PTO lines (lubrication, clutch engagement and brake) on the PTO casing unions.
- Refit the tie-rod on the PTO speed selection external lever.
- Refit the sheath on the support bracket.
- Raise the support with pick-up hitch hook using a chain and secure to the PTO with the six retaining bolts.
- Refit the tow bar and the three-point linkage device tie-rod.
- Fill the transmission/gearbox casing with oil.
- Reconnect the battery negative lead.
- Apply the torque settings listed on page 6.



42

Op. 31 116 47, 31 116 55, 31 116 58 ELECTROHYDRAULIC POWER TAKE-OFF HOUSING D.A.

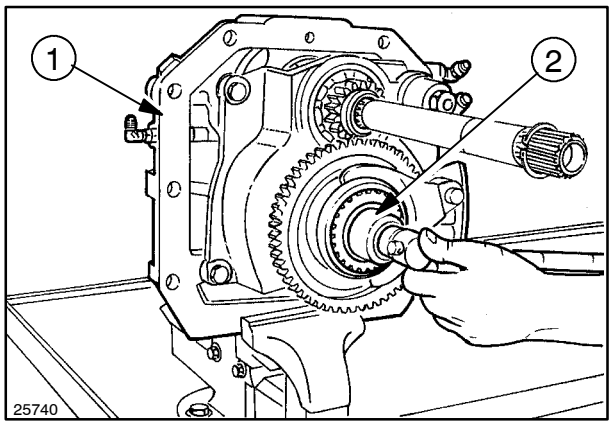
NOTE: *PTO unit overhaul operations must be carried out on a workbench.*

CAUTION

Handle all parts carefully.

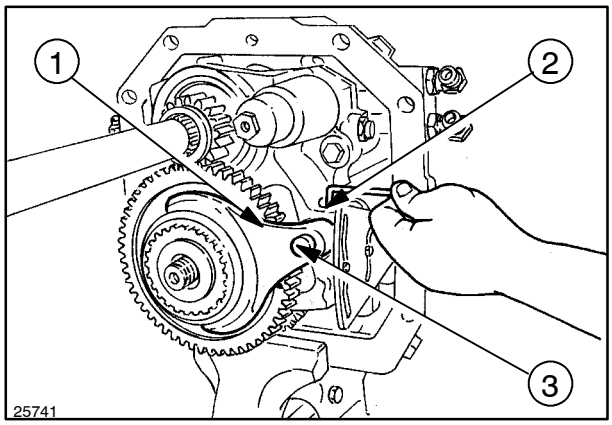
Do not put your hands or fingers between parts. Wear suitable safety clothing – safety goggles, gloves and shoes.

1. Secure the PTO (1) in the vice on the workbench and detach lifting hook **380000227** with chain. Remove the securing ring and unscrew the driven shaft lock nut (2).



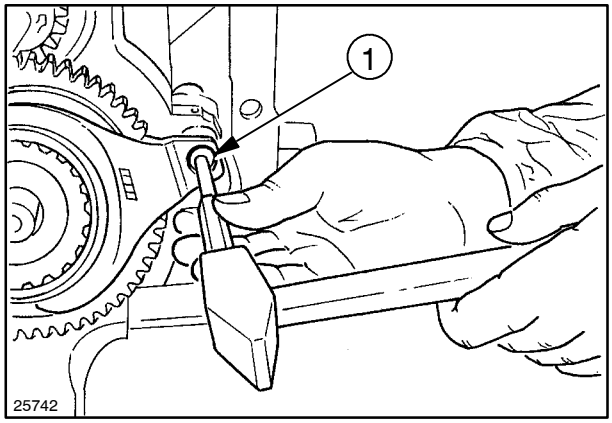
43

2. Take out the Allen screw fixing the rod (3) carrying the forks (1) on the support (2).



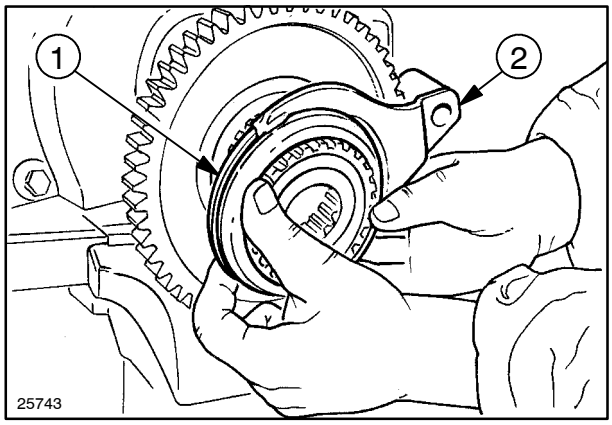
44

3. Extract the rod (1) with a punch.



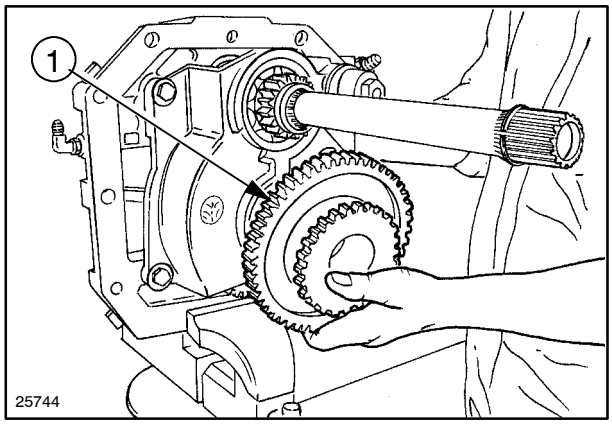
45

4. Remove the fork (2) and the engagement sleeve (1).



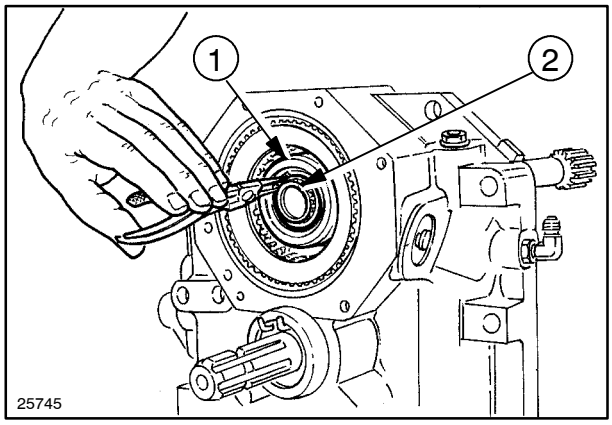
46

5. Remove the 750 rpm driven gear (1) and the bearing thrust ring.



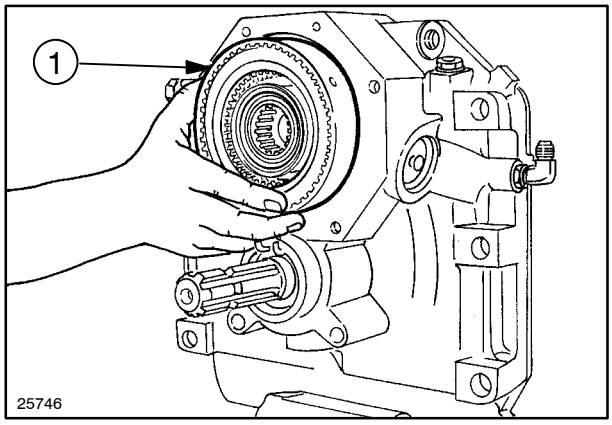
47

6. Extract the retaining snap ring (2) and remove the clutch driving disks support with relative bearing (1).



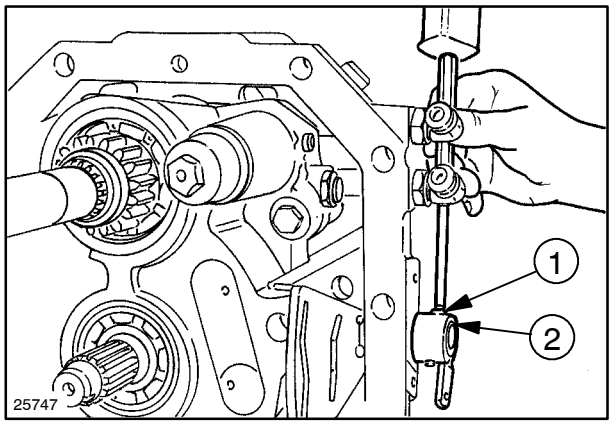
48

7. Remove the external support with the hydraulic clutch disks (1).



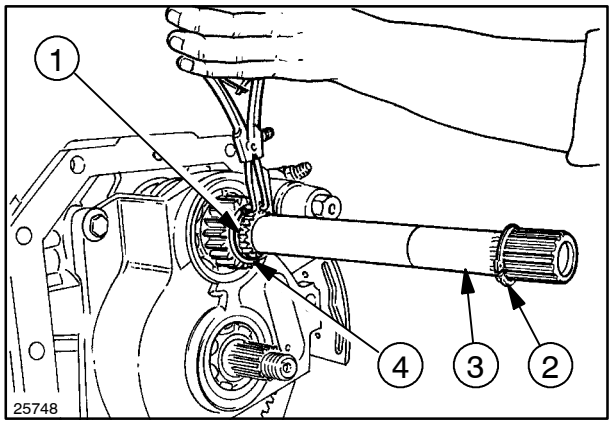
49

8. Using a mallet and punch, extract the speed selection (2) external lever securing pin (1) and remove the relevant parts.



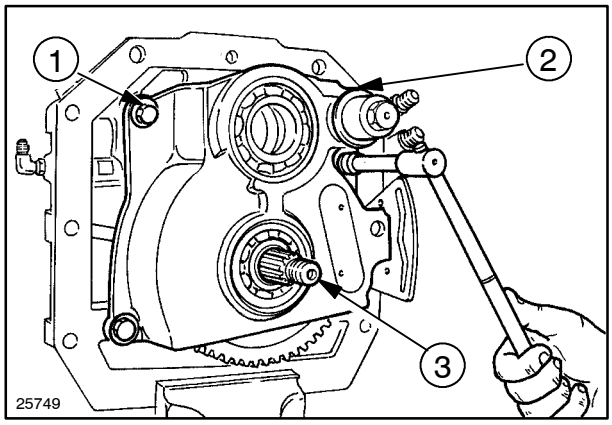
50

9. Remove the snap rings (1) and (2) and extract the driving shaft (3) tapping on the end with a plastic mallet; remove gear unit (4).



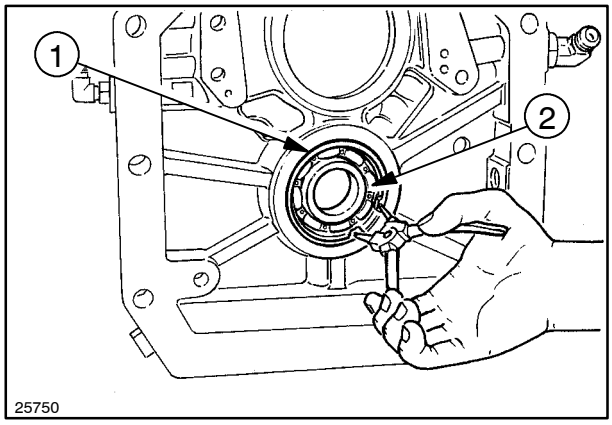
51

10. Take out the four bolts (1) securing the gear support (2). With the pliers compress the terminal parts of the PTO terminal shaft, remove the snap ring and extract the shaft (3) from the rear part. Remove all parts, including the thrust washers.



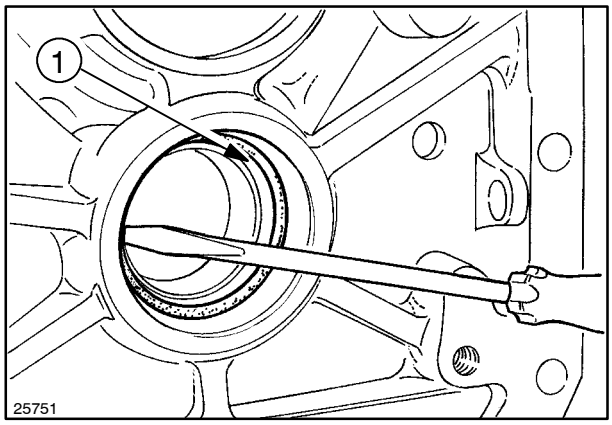
52

11. Remove the retaining circlip (1) and extract the bearing (2) from the PTO cover.



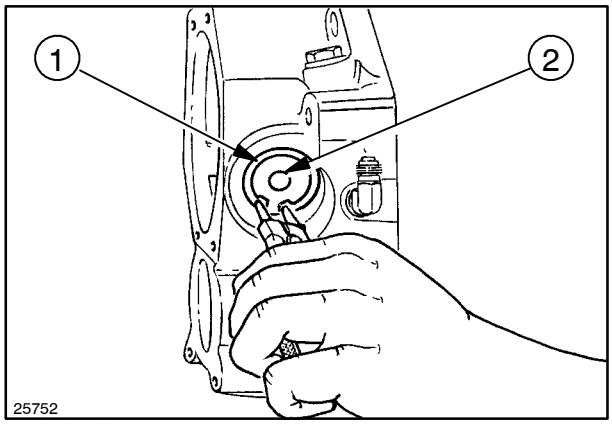
53

12. Using a screwdriver extract the oil seal (1) from the PTO cover.



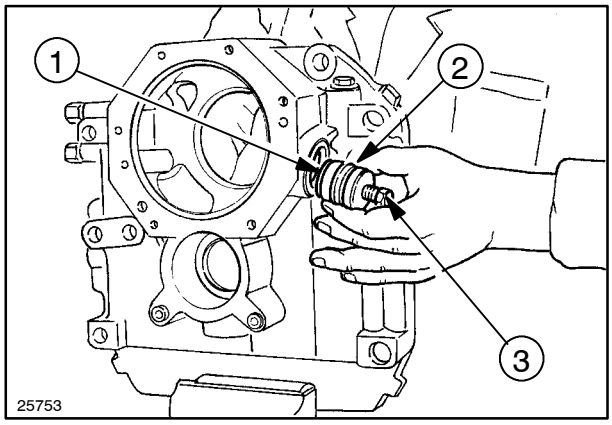
54

13. With pliers, remove the snap ring (1) and the cover (2).



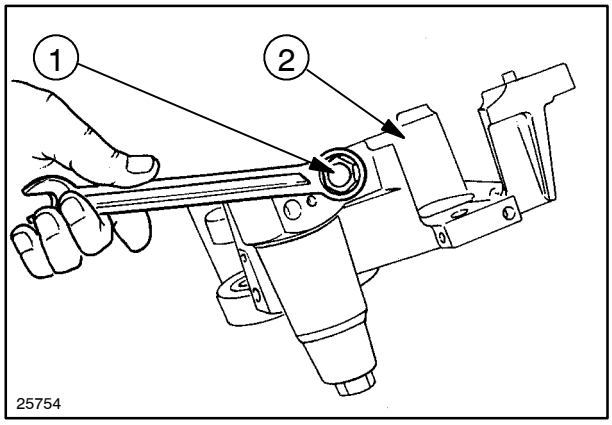
55

14. Tighten the screw (3) in the threaded hole on the piston (1), extract the piston and check the condition of the O-ring seal (2).



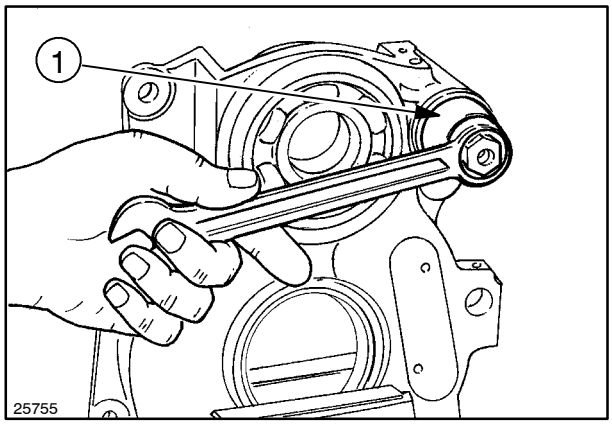
56

15. Unscrew the pressure relief valve (1) on the lubrication line of the internal gear support (2).



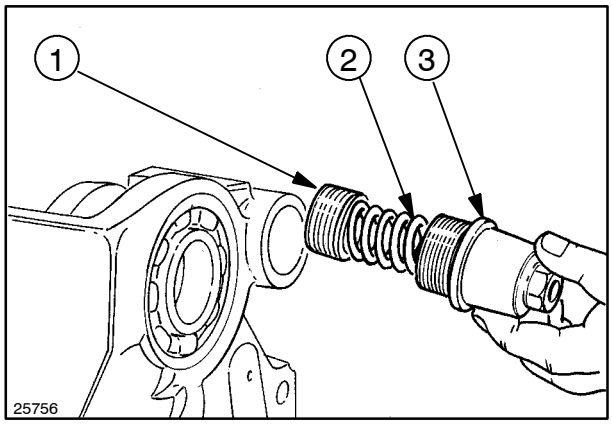
57

16. Remove the accumulator cap (1).



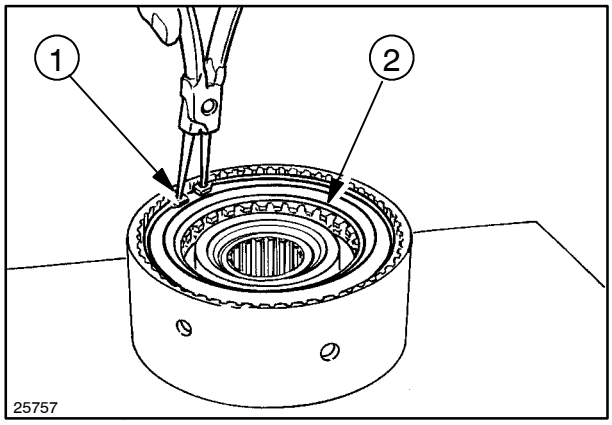
58

17. Remove the accumulator components, i.e.: the piston (1), the spring (2), the cover (3).



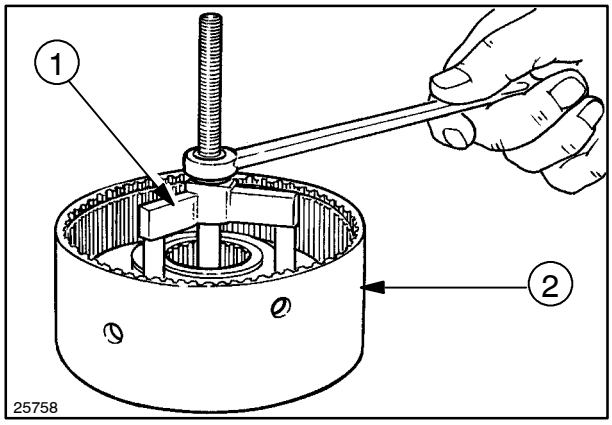
59

18. Remove the snap ring (1) the clutch disks reaction ring (2), and the driving and driven clutch disks.



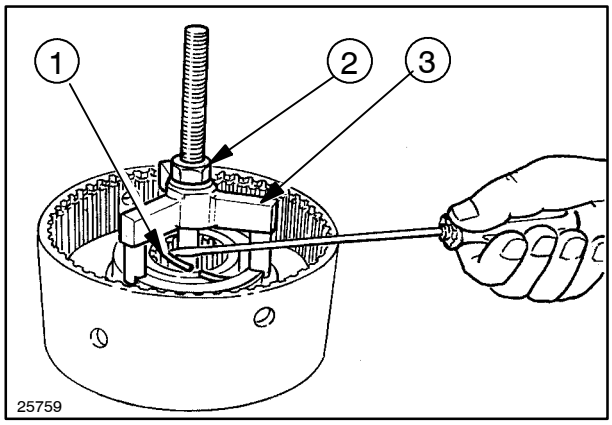
60

19. Fit spring press tool **380000243** (1) on the disks support (2) as shown in the figure, tighten the tool to compress the internal spring.



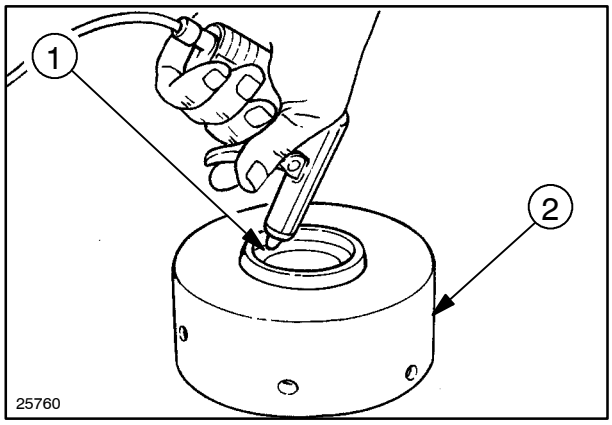
61

20. When possible, remove the snap ring (1) using a screwdriver. Loosen nut (2) and disassemble tool **380000243** (3).



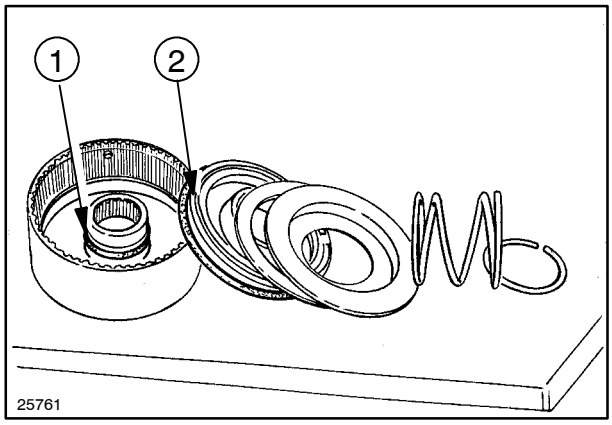
62

21. Using a compressed air gun, expel the piston (1) from the disk support (2).



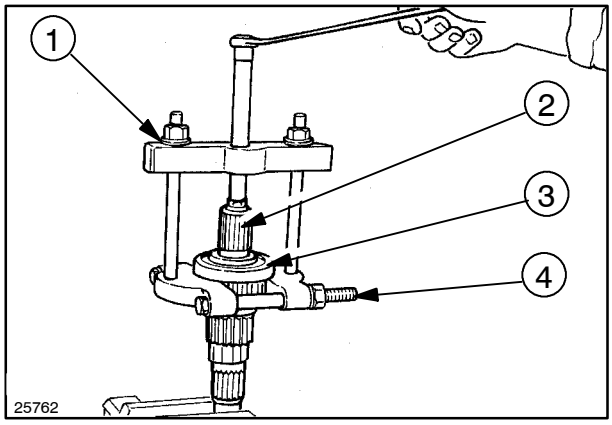
63

22. Remove and check the condition of all parts, replacing O-ring seals (1) and (2), if necessary.



64

23. Fit the extractor with separator (4) on the driving shaft (2) and secure in the vice. Assemble extractor (1) and connect to extractor (4). Position a plate on the end of the shaft (2) and tighten the extractor until the bearing (3) is extracted.



65

24. **Assembly.**

Check the condition of all components, especially the clutches and seals, and replace any worn parts.

To reassemble the PTO unit parts, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Insert the cylinder (9, fig. 3) in the sliding seat, fit the spring (10) and the spring rear retaining plate.

- Apply tool **380000243** (3, fig. 62) as shown in the figure, tighten nut (2) to load the spring (10) and when possible, insert the retaining ring (1) on the spring rear plate (10), then remove tool **380000243**.

- Heat the intermediate bearing and fit on the shaft (5, fig. 3), then assemble the clutch control cylinder on the shaft (5).

- Alternately mount the driven (12) and driving (11) disks on the clutch casing, fitting the external reaction ring (2, fig. 60) with the retaining snap ring (1).

- Refit the piston, the spring and the accumulator cover (as shown in fig. 59).

- Refit the pressure relief valve (as shown in fig. 57).

- Reassemble the brake and secure the cover with the snap ring (as shown in fig. 55).

- Refit the oil seal (1, fig. 54), using a punch to correctly position the seal.

- Position the PTO cover in the vice, fit the rear bearing (2, fig. 53) and the retaining snap ring (1).

- Assemble the speed selection lever (2, fig. 50) on the cover and secure with the spring pin.

- Fit the spacer between the rear bearing and the 1000 rpm driven gear on the driven shaft (22, fig. 3).

- Assemble the 1000 rpm driven gear, complete with sleeve, fork and bushing.

- Partially insert the speed selection lever rod (1, fig. 45) so that the 540 and 1000 rpm gear engagement sleeve is held in position.

- Insert the 540 rpm gear and front bearing thrust washer on the shaft (22, fig. 3).

- Fit the gear support (2, fig. 52) and bearings.

- Refit the driving shaft (3, fig. 51) with the clutch disk locking cylinder (previously assembled), then gear unit (4) and the retaining snap rings (1) and (2).

- Position the spacer between the gear (3, fig. 3) and the front bearing on the driven shaft.

- Fit the 750 rpm driven gear (1, fig. 47), then the engagement sleeve (1, fig. 46) and the fork (2).

- Fit the nut (2, fig. 43) and tighten to the torque value indicated on page 6 securing the edge on the driven shaft thread to prevent the nut from loosening.

- Lock the fork support rod (3, fig. 44) with the retaining Allen bolt on the support (2).

NOTE: *For the assembly of the remaining parts see the description of the refitting operations (see figs. 40- 41- 42).*

SECTION 33 - BRAKES

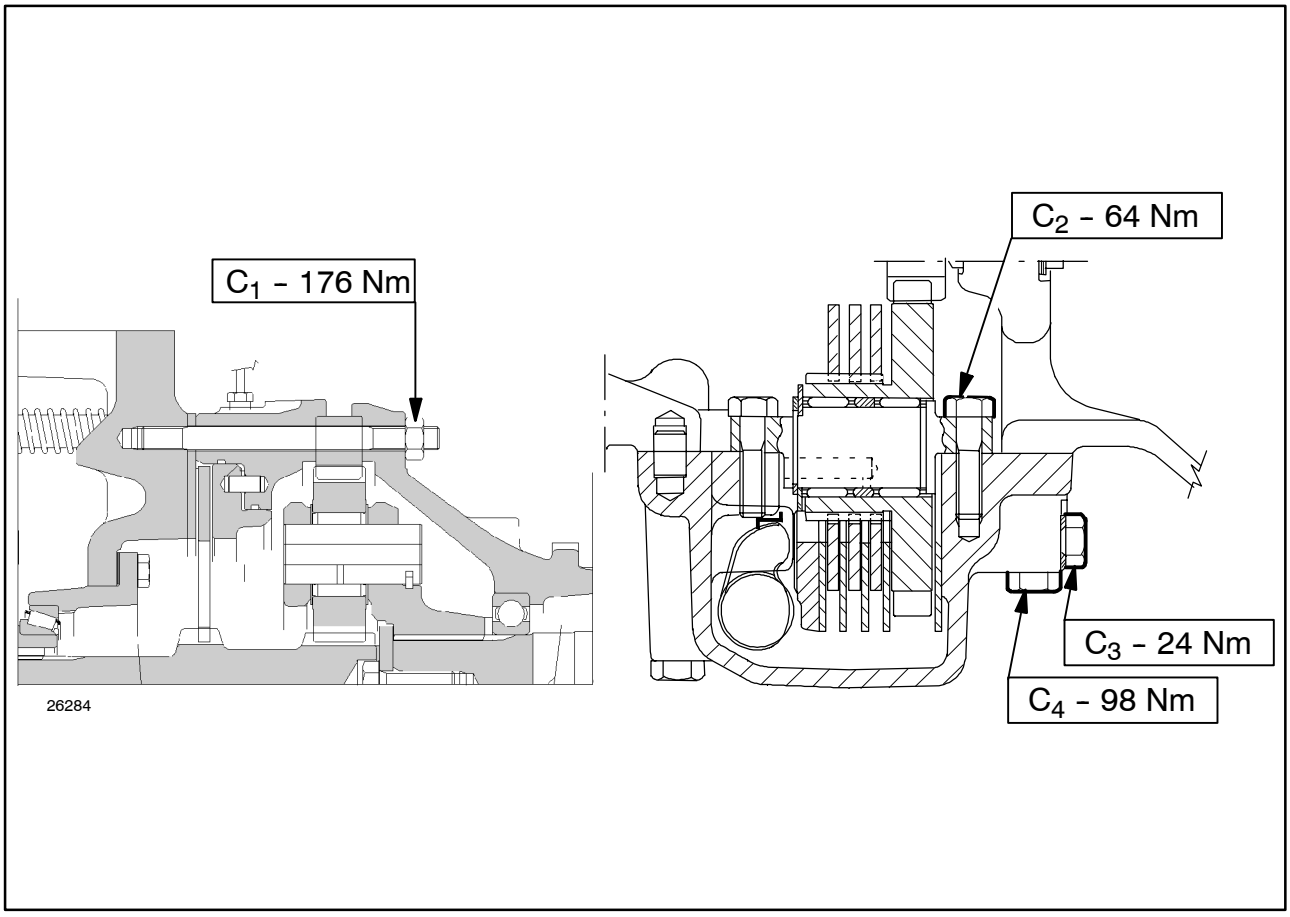
Chapter 1 - Brakes

CONTENTS

Operation	Description	Page
	Data	1
	Tightening Torques	2
	Cross-sectional views	3
	Description and Operation	4
	Fault diagnosis	7
33 110 08	Handbrake control. Travel adjustment	8
33 110 20	Parking brake casing. R.I.	9
33 110 26	Parking brake casing. D.A.	9
33 202 04	Brake hydraulic system. Air bleed	12
33 202 46	Service brake pump. R.I.	13
33 202 60	Service brake cylinder. R.I.	15

DATA

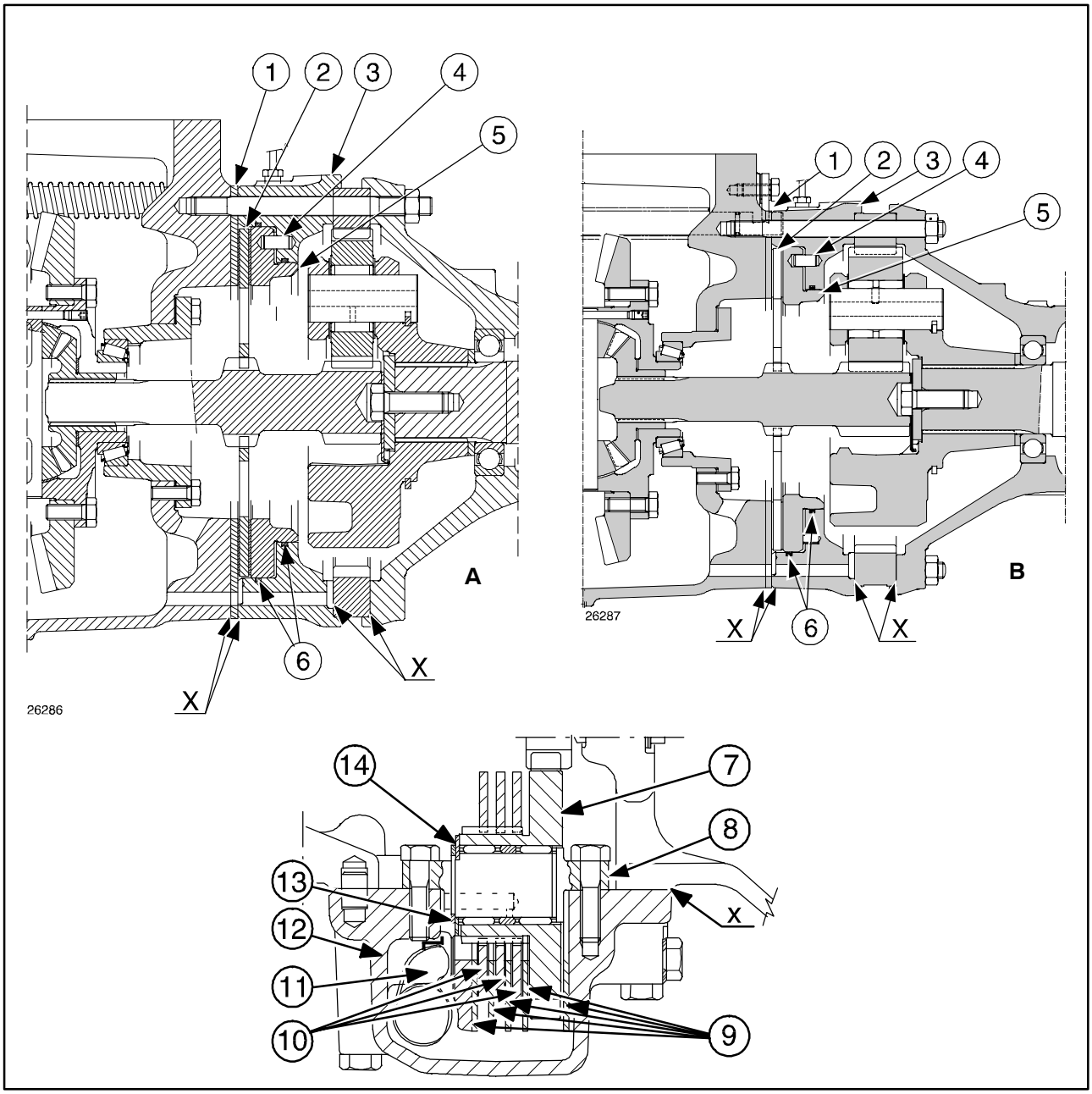
Type:		
- service brake		with oil bath disk, acting on differential drive shafts
- parking brake		with oil bath disks, engaging a gear on the bevel pinion shaft
Operating:		
- service brake		hydrostatic, with independent pedals (connected by means of a pin)
- parking brake		mechanical, by means of a hand lever
Service brake disk material		sintered
Parking brake disk material		steel
Parking brake mobile sectors material		sintered or organic agglomerate
Disk thickness:		
- service brake	in. (mm)	0.3937 (10)
- wear limit	in. (mm)	0.3385 (8.6)
- parking brake	in. (mm)	0.1555 to 0.1594 (3.95 to 4.05)
Parking brake mobile sectors thickness:		
- lateral sectors	in. (mm)	0.1220 to 0.1338 (3.1 to 3.4)
- intermediate sectors	in. (mm)	0.1653 to 0.1771 (4.2 to 4.5)
Hydrostatic control		
Hydraulic pump		with 2 master cylinders independently operated by brake pedals
Working pressure	psi (bar)	255.27 (17.6)
Bleeding air from brake circuits		see page 12
Control pedal adjustment		see page 14



1

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Nut securing final drive to transmission casing (C_1)	M 14 x 1.5	176	18
Bolts retaining shaft for parking brake driven gear (C_2)	M 10 x 1.25	64	6.5
Guide bolts for parking brake mobile sector (C_3)	M 12 x 1.25	24	2.5
Bolt retaining parking brake support to transmission casing (C_4)	M 12 x 1.25	98	10

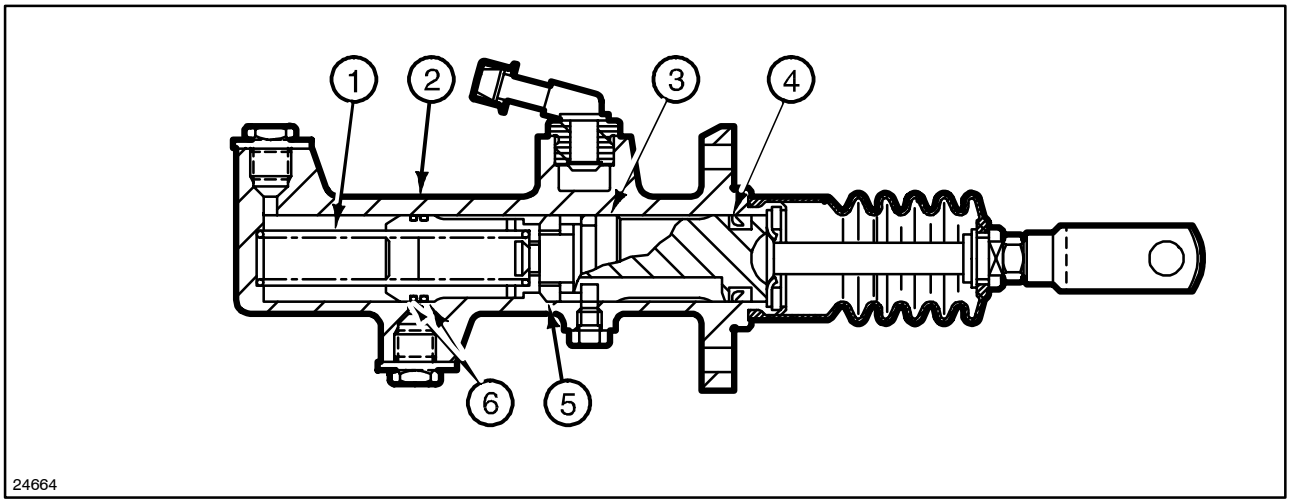


2

Service brake and parking brake sectional drawings

A. Models TL70.
B. Models TL80, TL90 and TL100.
1. Brake wear disk.
2. Service brake disk.
3. Final drive casing spacer.
4. Guide grub screw.
5. Brake drive piston.
6. Seals.
7. Driven gear.
8. Driven gear pin (7).
9. Braking sectors.
10. Parking brake disks.
11. Parking brake internal control lever.
12. Parking brake support.
13. Circlip.
14. Thrust washer.

NOTE: *During assembly apply sealing compound on surfaces marked with an* ***X*** *as shown on pages 11 and 19.*



3

Service brake sectional drawing

1. Spring.
2. Pump body.
3. Control piston.
4. Rear seal.
5. Central seal.
6. Front seals.

DESCRIPTION AND OPERATION

SERVICE BRAKES (see fig. 4)

The service brakes are the hydraulically operated wet disk type.

The two control pumps (one for each pedal) are located in the front part of the cab and are connected to their pedals (3) by means of tie-rods.

The pumps can be operated on their own by each pedal, or as a pair with both pedals (connected by a pin).

The connecting pipe (6) between the two pumps ensures balanced braking, even when the brake disks are not equally worn.

The control pumps are fed from a single reservoir installed on the pumps.

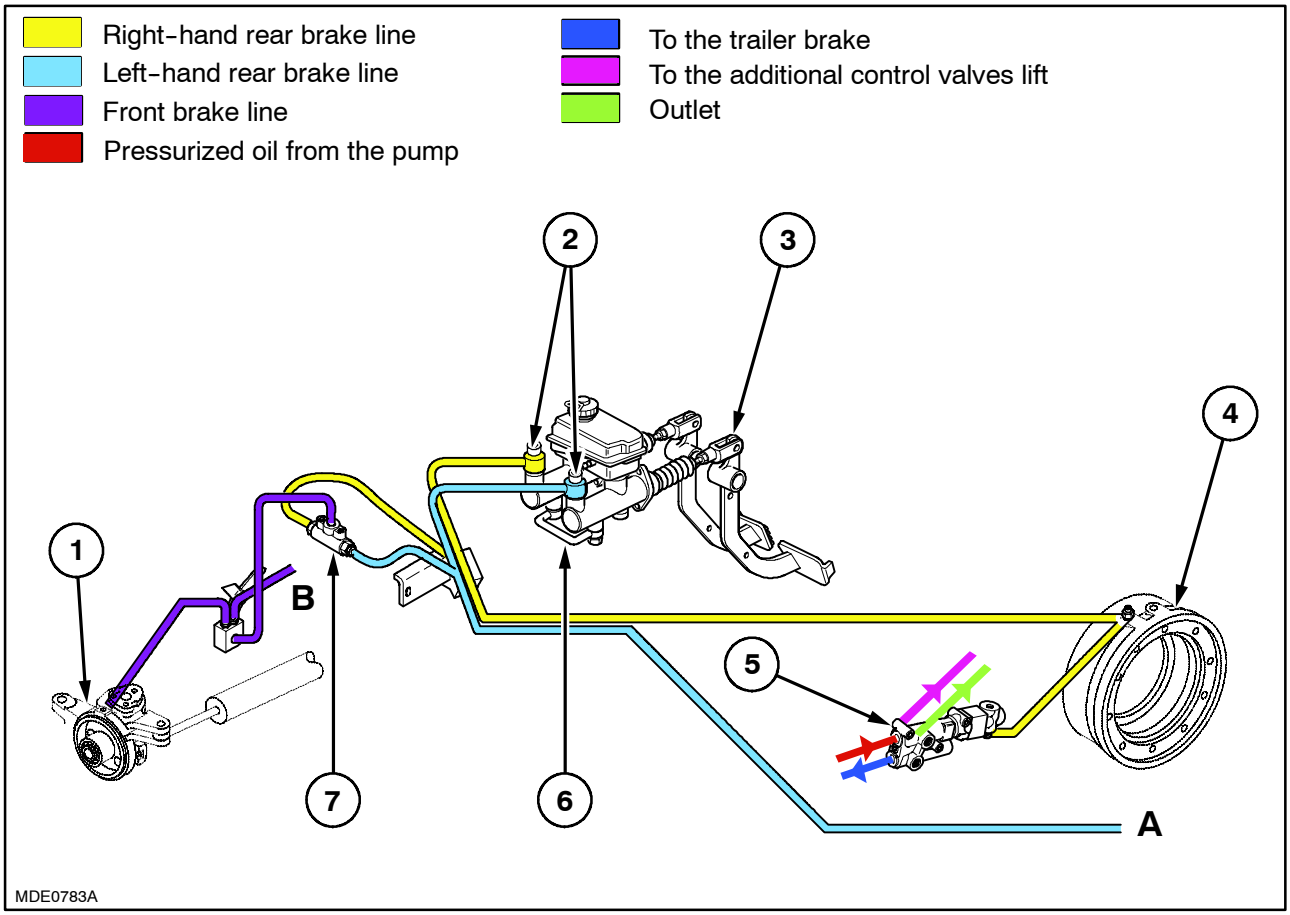
The brake disks (one for each rear wheel) are located between the rear transmission casing and the final drive casing. The disks are mounted on the differential drive shafts.

PARKING BRAKE (see fig. 2)

The parking brake is operated by a control lever on the left-hand side of the operator.

When acting on the control lever, a flexible tie-rod operates the lever (11) inside the parking brake support (12), bearing the brake sector assembly (9) and the brake disks (10) keyed onto the driven gear (7) and locking it.

Locking the rear bevel pinion shaft intermediate gear (7), locks the rear bevel pinion shaft too and therefore the tractor cannot move.



4

Hydraulic diagram of brakes

A. To the left-hand rear brake.
B. To the right-hand front brake.
1. Left-hand front brake.
2. Pressure switches.
3. Hydraulic brakes.
4. Right-hand rear brake.
5. Trailer brake valve.
6. Pressure balancing pipe.
7. Pilot valve.

NOTE: *See pilot valve on page 6.*

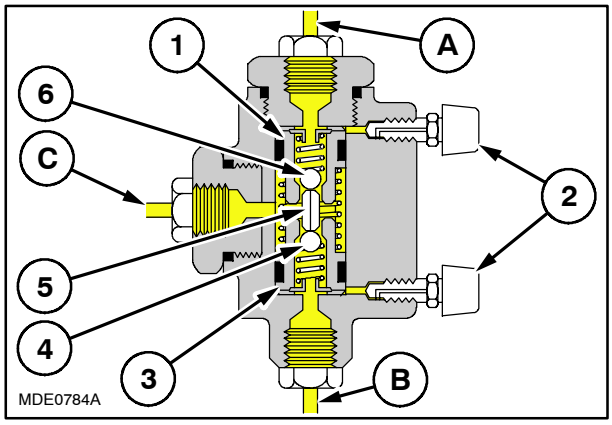
1 *The pressure switches (2) are normally closed, they only open on braking.*
If you operate just one pedal, the differential lock is disengaged.
If you operate both pedals, four-wheel drive is engaged, the brake lights come on and the differential lock is disengaged.

2 *Operating both pedals, moreover, applies front braking.*

Pilot valve operation

Brakes at rest.

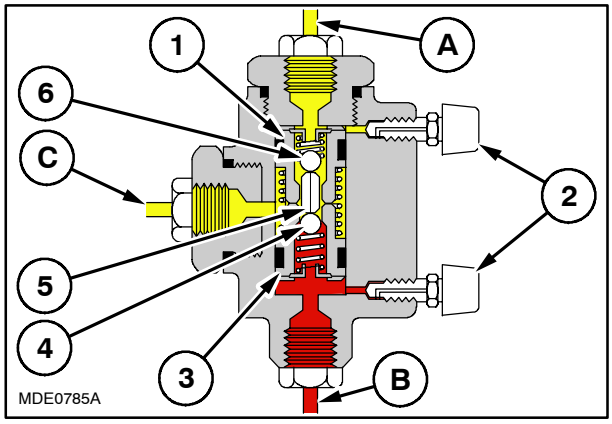
When the tractor's brakes are at rest, there is no pressure on the pipes (A - B - C).



5

Braking applied on just one pedal.

When pressing just one brake pedal (for instance, the one operating the right-hand rear brake), the pressure reaches the pilot valve through the pipe (B), shifts the ball (4) in contact with the tapered seat of the piston (3) bringing this into contact with the piston (1). No pressurized oil comes from the pipe (A), accordingly the ball (4) shifts the pin (5) and the ball (6) towards the piping (A). The oil pressure keeps the ball (4) in contact with the tapered seat of the piston (3) obstructing the flow of oil being delivered to the front brakes through the piping (C) and accordingly the front brakes are not subjected to braking.



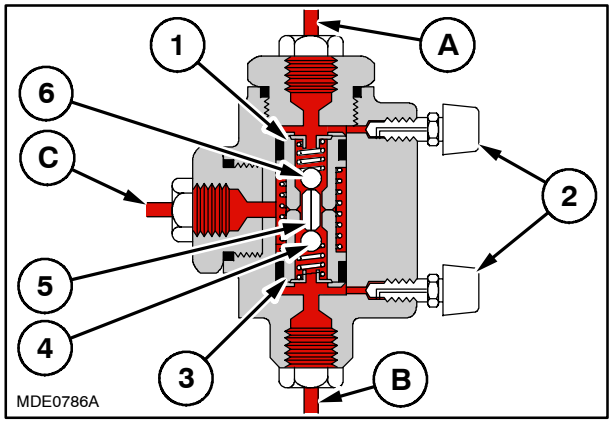
6

Braking applied on both brake pedals.

When both brake pedals are pressed, the pressurized oil reaches the pilot valve via both pipes (A and B).

The pressurized oil shifts the pistons (1 and 3) towards the centre of the valve while the pin (5) keeps the balls (4 and 6) detached from the tapered seats on the pistons (1 and 3).

In this position, the oil can arrive under pressure through the piping (C) with an according braking action of the front brakes.



7

A. Oil from the left-hand brake cylinder.
B. Oil from the right-hand brake cylinder.
C. OIl delivered to the front brakes.
1. Left-hand piston.
2. Bleeding devices.
3. Right-hand piston.
4. Ball.
5. Pin.
6. Ball.

Tractor brake circuit oil (brakes off)

Tractor brake oil circuit (under pressure)

BRAKE TROUBLESHOOTING

Problems	Possible Causes	Solutions
Brake pedals hard to operate.	1. Corresponding master cylinder seized.	Replace the brake control pump.
	2. Brake control pipes obstructed or pinched.	Clean or replace the control pipes.
The brakes stick when the pedals are released.	1. Brake control pump pistons locked.	Release the piston and, if necessary, replace the brake control pumps.
	2. Master cylinders seized.	Replace the brake control pumps.
Braking noisy.	1. Friction material on brake disks worn (2, fig. 2).	Replace the brake disks.
Pedal stroke too long.	1. Air in the brake circuit.	Bleed air from the brake circuit.
	2. Brake control pumps worn.	Replace the brake control pumps.
	3. Leakage from control pipes.	Eliminate the cause of the leakage.
Unbalanced braking.	1. Incorrect tyre pressure.	Inflate the tyres to the correct pressure.
	2. Brake control pumps worn.	Replace the brake control pumps.
	3. Pump connection pipes obstructed or pinched.	Clean or replace the pipes.
	4. Brake control pipes obstructed or pinched.	Clean or replace the control pipes.
	5. Pump control piston seals worn or damaged.	Replace the brake control pumps.
	6. Friction material on brake disks worn (2, fig. 2).	Replace disk.
Inefficient braking.	1. Friction material on brake disks worn (2, fig. 2).	Replace the brake disks.
	2. Brake control pumps worn.	Replace the brake control pumps.
	3. Air in the brake circuit.	Bleed air from the brake circuit.
	4. Leakage from control pipes.	Eliminate the cause of the leakage.
	5. Pump control piston seals worn or damaged.	Replace the brake control pumps.
Parking brake does not lock.	1. Brake control incorrectly adjusted.	Adjust correctly.
	2. Braking sectors worn (9, fig. 2).	Replace the braking sectors.
The tractor remains braked when the parking brake is disengaged.	1. Control return stroke obstructed.	Remove obstructions.
	2. Braking sectors (9, fig. 2) seized on brake disks.	Release and replace damaged parts.

Op. 33 110 08
HANDBRAKE CONTROL
Travel adjustment

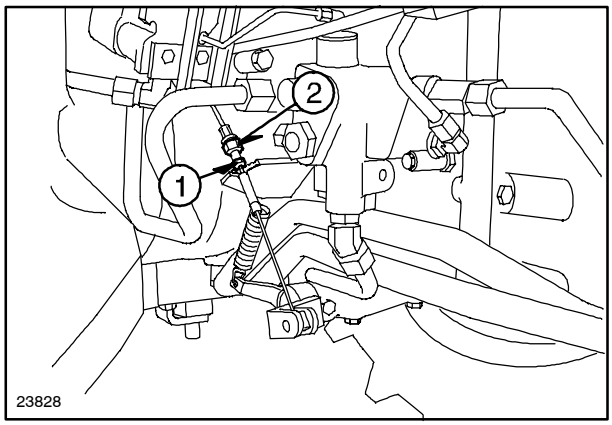
The parking brake lever must be adjusted whenever service operations are carried out on the assembly, and if the lever is not positioned in the third notch when the brake is engaged.

Proceed as follows.

1. Slacken the locknut (1).

2. Adjust the screw (2) until the lever locks on the third ratchet.

3. Tighten the locknut (1).



8

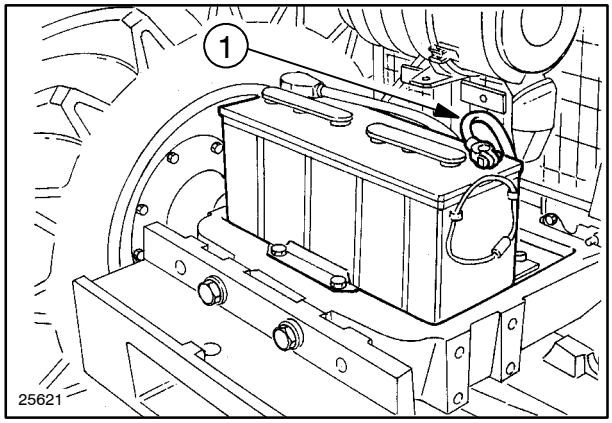
Op. 33 110 20 and Op. 33 110 26
PARKING BRAKE CASING
R.I. and D.A.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

To disassemble the support (12, fig. 2) of the parking brake proceed as follows.

1. Disconnect the battery negative lead (1).

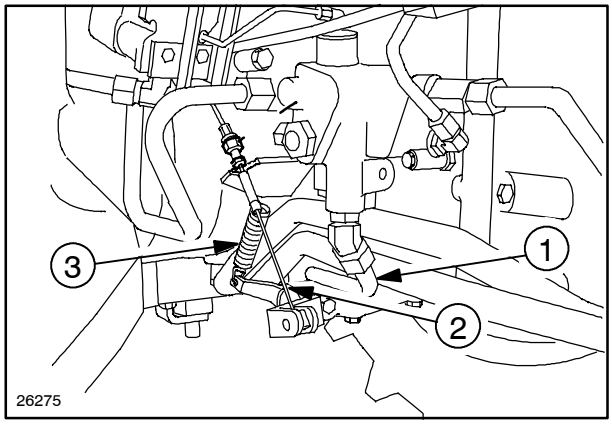


9

2. Lock the front wheels using chocks.

3. Drain the oil from the transmission-gearbox casing.

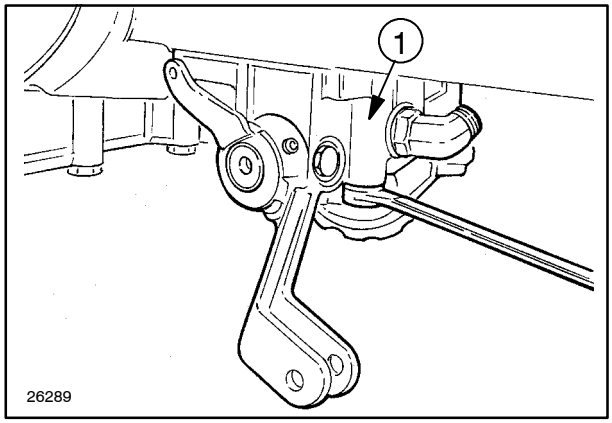
4. Disconnect the control linkage (2) and the return spring (3); if applicable, remove the outlet pipe (1) for the auxiliary control valves.



10

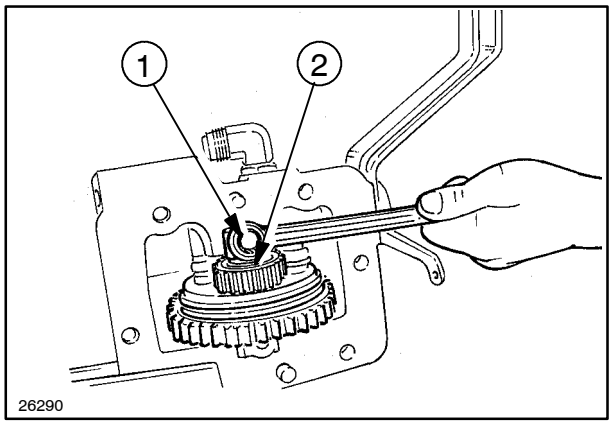
5. Detach the services solenoid valve support following the description in Section 31.

6. Unscrew the retaining bolts and remove the braking sector support (1).



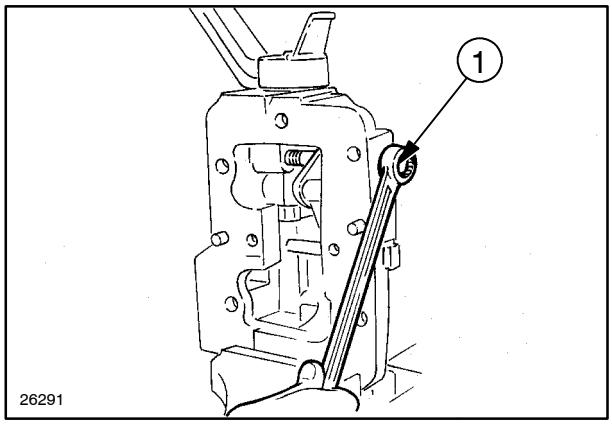
11

7. Take out the retaining bolts (1) and remove the pin (2) together with the brake disks and gear.



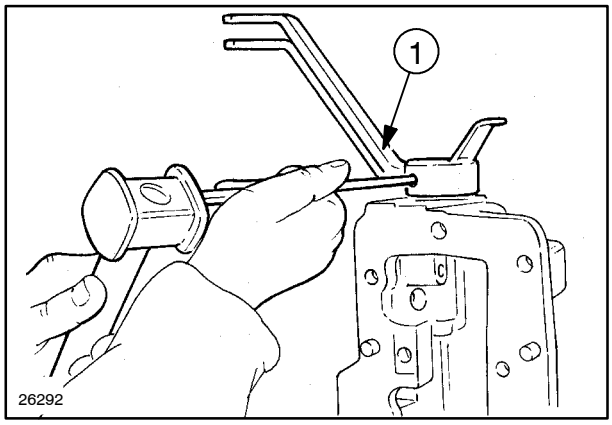
12

8. Unscrew the brake sectors support bolts (1) and remove.



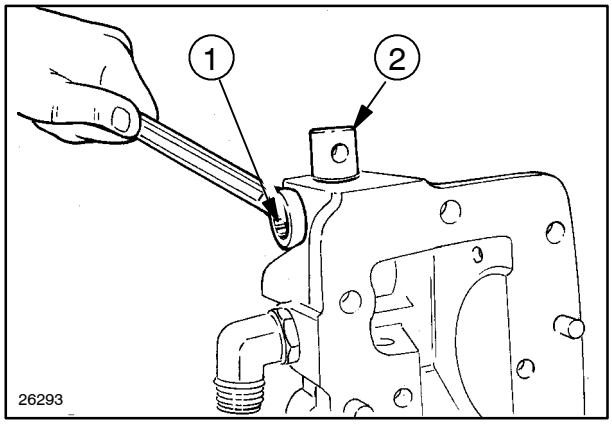
13

9. Extract the retaining pin and remove the external lever (1) controlling the parking brake.



14

10. Remove the stop bolt (1) and extract the internal lever (2) controlling the parking brake.



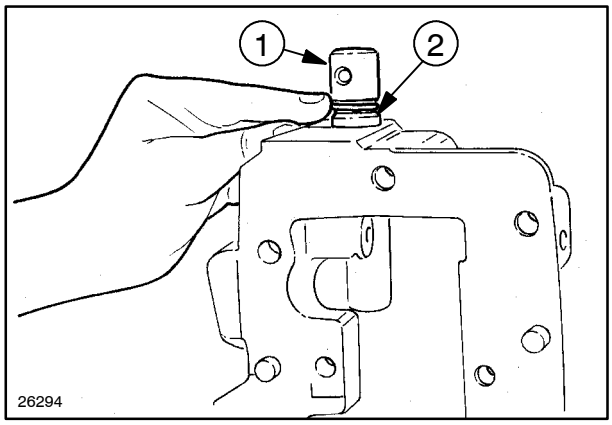
15

11. To assemble and refit the parking brake unit, proceed as follows.

CAUTION

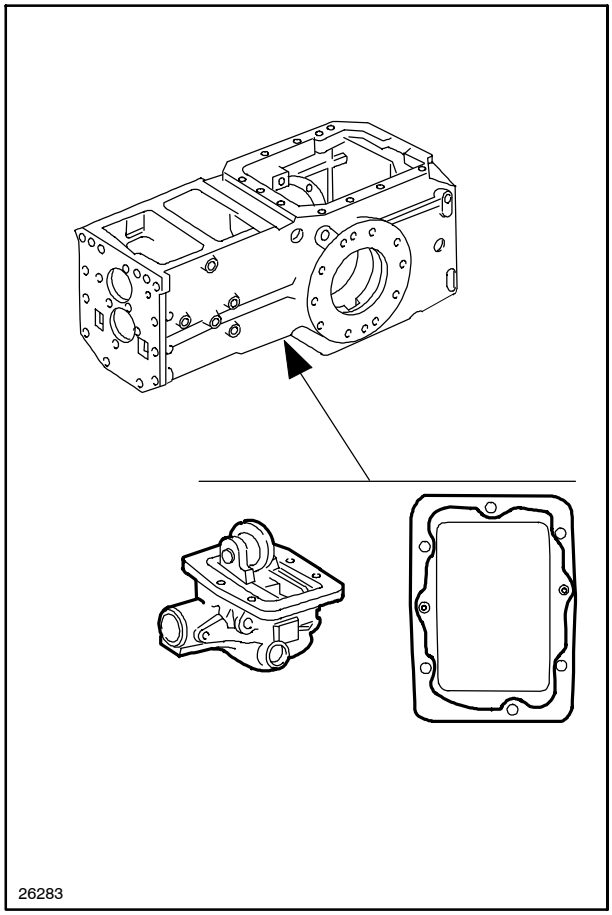
Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refer to the illustrations of fig. 2 for the correct orientation of the various parts.
- Before reassembling the parking brake support on the rear transmission casing, carefully clean and degrease the mating surfaces, then apply sealing compound [approx. 0.0787 in. (2 mm)] along the marked line shown in the drawing below.
- Apply the torque settings listed on page 2.
- Insert the internal lever (1), without O-ring, on the support until the O-ring seat is fully visible. Place the O-ring (2) in the seat and push the internal lever (1) into position, securing with the screw.



16

- Assemble the parking brake external lever.
- Fit the brake sectors and relative support screws.
- Fit the pin, brake disk and gear unit.
- Position and secure the brake sectors support to the transmission-gearbox casing.
- Refit the services solenoid valves support.
- Connect the return spring, control wire and auxiliary control valves drainage line.
- Fill up the rear transmission-gearbox casing. for products and quantities see Section 00.
- Connect the negative cable to the battery.



17

Mastic application diagram for assembly of parking brake support to the transmission casing

The types of sealing compound are listed in section 00.

Op. 33 202 04
BRAKE HYDRAULIC SYSTEM

Air bleed

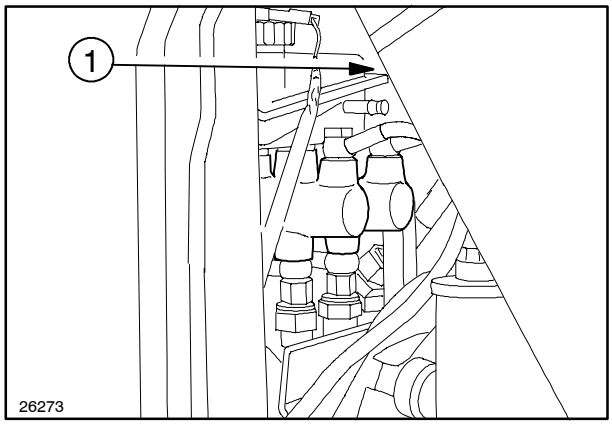
Air must be bled out whenever carrying out work on the brake hydraulic system.

Proceed as follows.

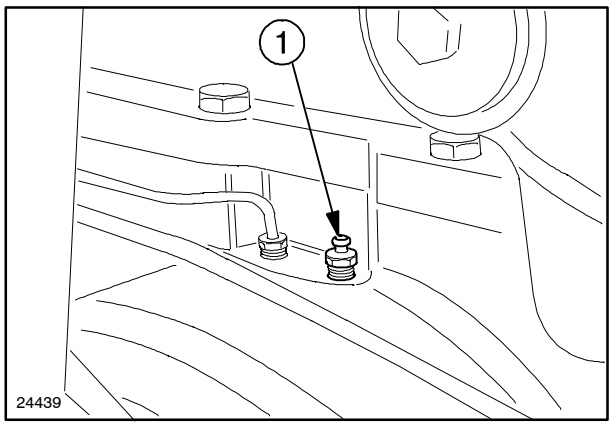
1. Thoroughly clean the external parts of the assemblies near the bleeding screws (1, fig. 19) and the hydraulic oil reservoir cover (1).
2. Check that the right-hand brake reservoir (1) is full, both before and during bleeding.

NOTE: *Carefully filter used oil before re-using.*

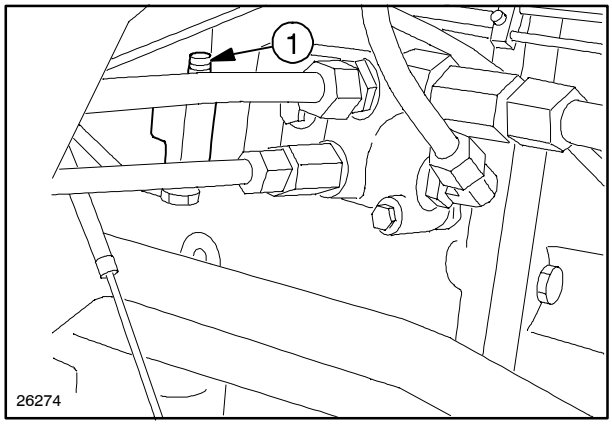
3. Push the left-hand brake pedal down, **slowly and fully**, so that the oil is put in pressure.
4. Keep the pedal pressed down, unscrew the bleeding screw (1) by half a turn, allowing the oil/air bubble mixture to flow out.
5. Tighten the screw (1) and repeat the aforementioned operation until oil without air bubbles flows out.
6. Press the brake pedals again to put the circuit under pressure, i.e.: when the pedal travel returns to normal.
7. Repeat the above steps for the right-hand brake pedal.
8. On completion of this procedure, fill up the reservoir with oil (1, fig. 18).
9. When the tractor is equipped with the trailer brake hydraulic control valve, carry out the above-mentioned operations then, working as described for the screw (1, fig. 19), bleed the air from the screw (1).
10. On completion of this procedure, fill up the reservoir with oil (1, fig. 18).



18



19



20

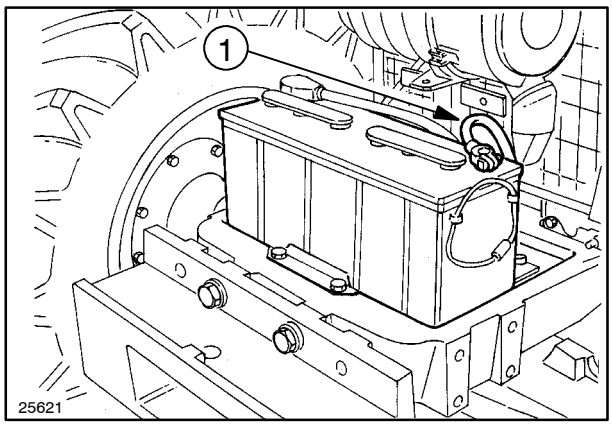
Op. 33 202 46
SERVICE BRAKE PUMP R.I.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

Proceed as follows to remove the hydraulic pump.

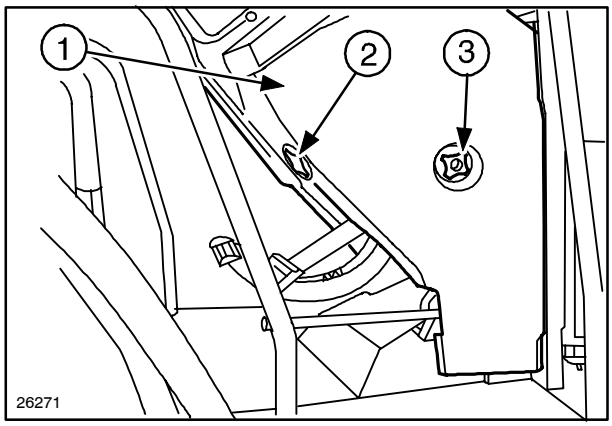
1. Disconnect the battery negative lead (1).



21

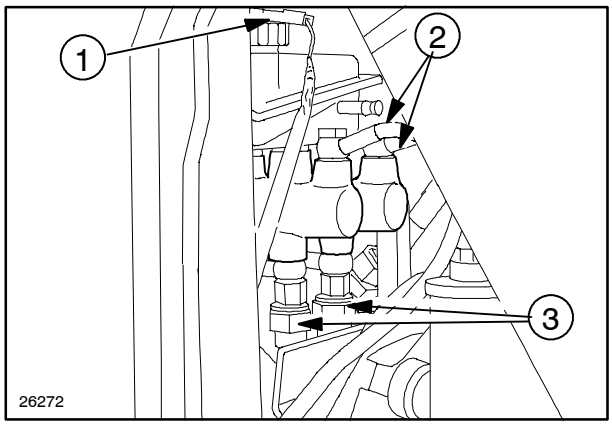
2. Lock the front wheels using chocks.

3. Remove the knobs (2 and 3) and the guard (1).



22

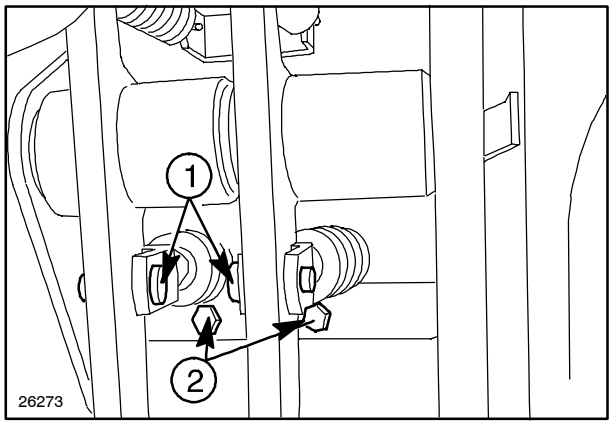
4. Disconnect the electrical connections: on the tank (1), pressure gauges (3) and detach the service brake lines (2).



23

5. Remove the spring clips and extract the brakes pump fork pivot pins (1).

6. Unscrew the bolts (2) securing the brakes pump to the cab and extract the pump from the engine side.



24

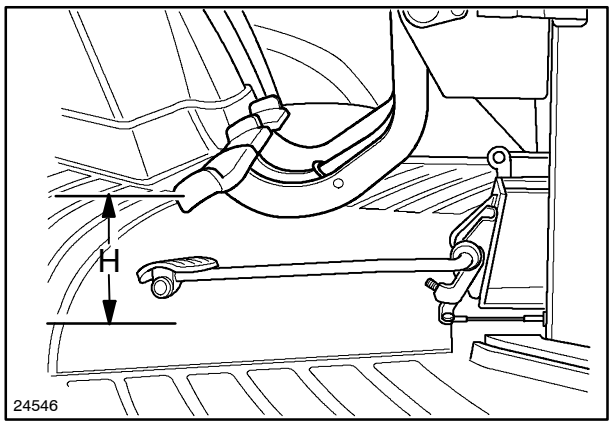
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

7. To refit the brake control hydraulic pump unit, proceed as follows.
- Fit and secure the pumps, and connect to the control pedals.
- Connect the lines and connections on the tank and pressure gauges.
- Connect the battery negative lead.
- Carry out the following adjustment operation and bleed the air from the circuit, as described on page 12.

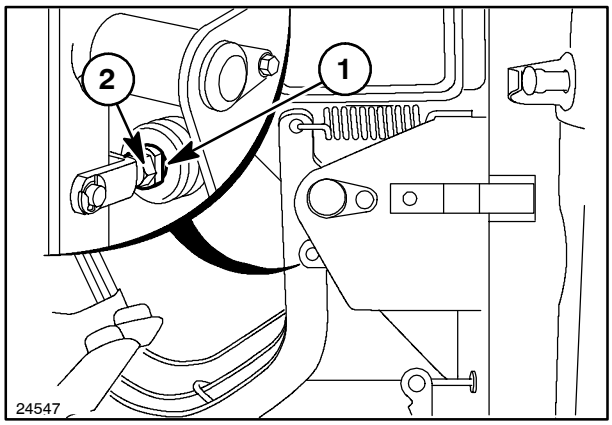
Adjusting the height of the service brakes pedals.

8. With the brake control pedals connected to the forks and the pedal connection pin extracted, check that the height (H), from the centre of the pedals to the top of the mat, is: 6.3779 (162 mm) for tractors fitted with a cab or 7.2834 in. (185 mm) for tractors fitted with no cab.



25

9. In order to adjust, loosen the locknuts (2), adjust the screw (1) to obtain the correct height (H) and then tighten the locknuts (2).



26

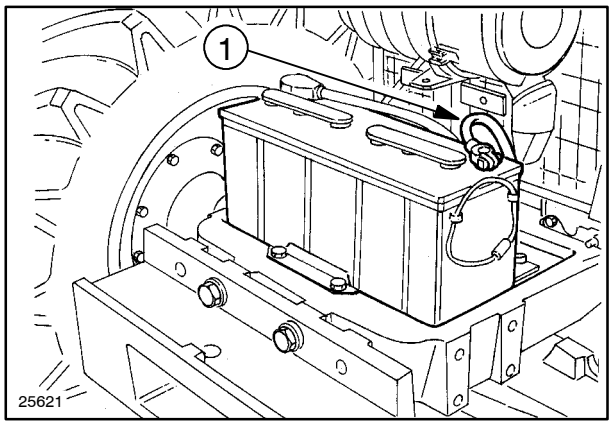
Op. 33 202 60
RIGHT OR LEFT BRAKE R.I.

DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

To remove the final drive casing proceed as follows.

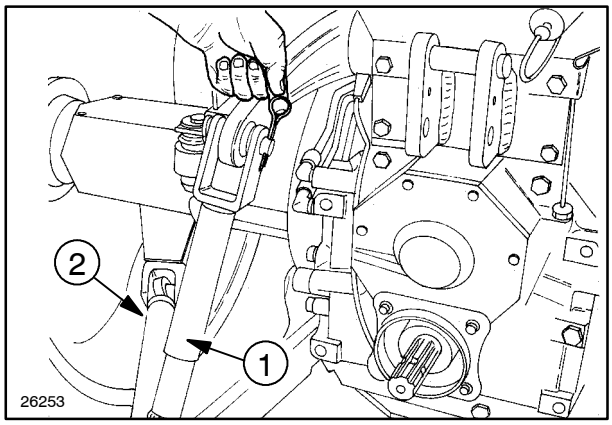
1. Disconnect the battery negative lead (1).



27

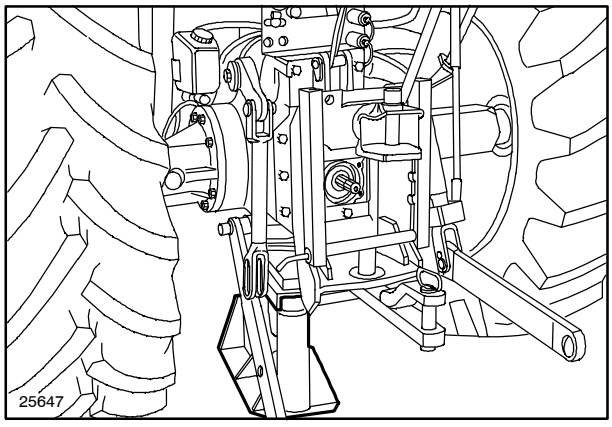
2. Lock the front wheels using chocks.

3. Detach the vertical tie-rod (1) and the LH anti-swing rod (2).



28

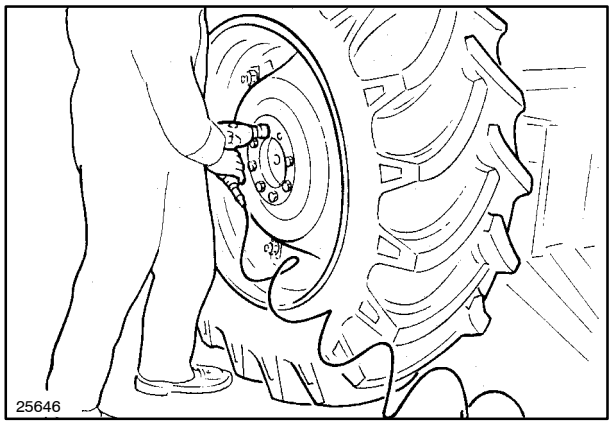
4. Raise the rear part of the tractor and position a fixed stand under the flex bar support.



29

5. Unscrew the retaining bolts and remove the rear LH wheel.

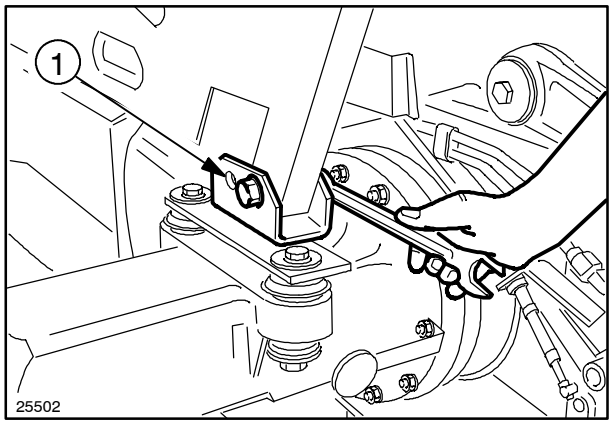
6. Detach the window washer liquid tank from the relative support bracket, disconnect the electrical connections and delivery lines.



30

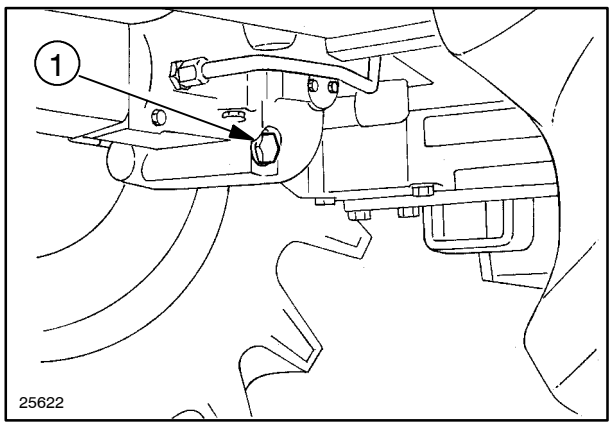
7. Unscrew the bolt securing the cab to the bracket (1).

8. Slightly raise the cab and position a wooden block between the hydraulic lift and the cab, making sure that there is no contact with the piping.



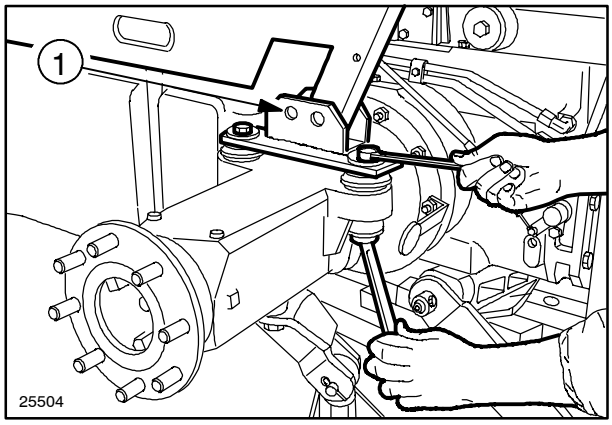
31

9. Take out the plug (1) and drain the oil from the gearbox-rear transmission casing.



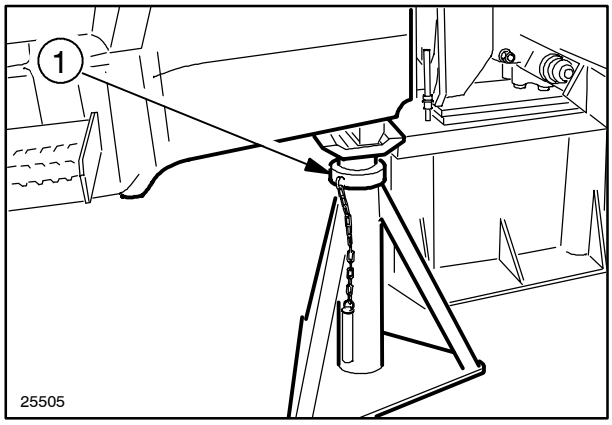
32

10. Take out the cab supporting bracket retaining bolts (1).



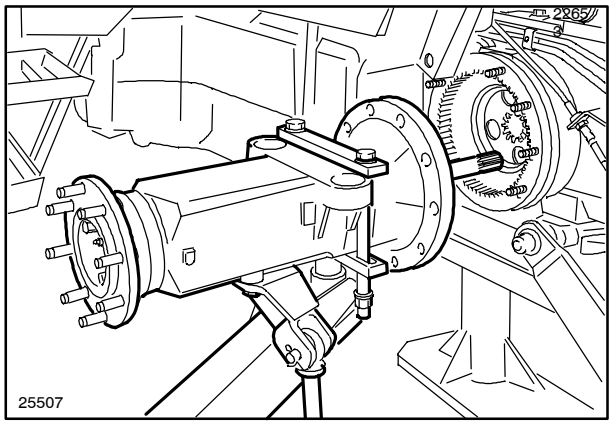
33

11. Position a stand (1) under the rear part of the fuel tank.



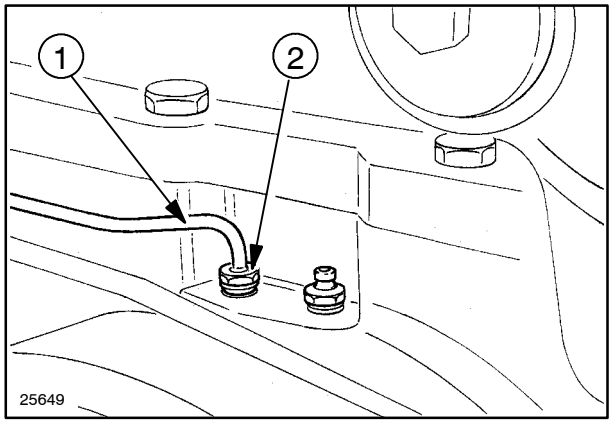
34

12. Connect the final drive casing to suitable equipment for lifting and retaining. Take out the retaining bolts and remove the final drive casing from the transmission casing.



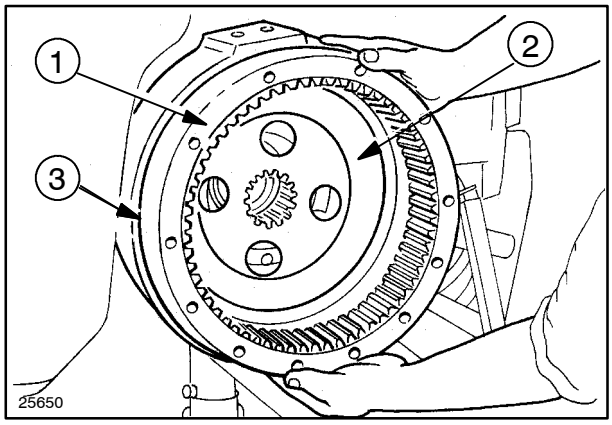
35

13. Remove the union (2), and detach the service brake control piping (1).



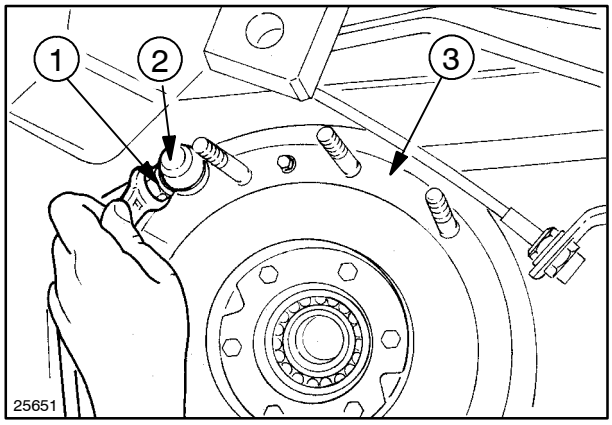
36

14. Detach the crown gear (1), the spacer (3) and the brake disk (2), from the transmission-gearbox casing.



37

15. Remove the differential lock piping (1) from the union (2), turn this to free the friction disk (3) and be able to remove it.

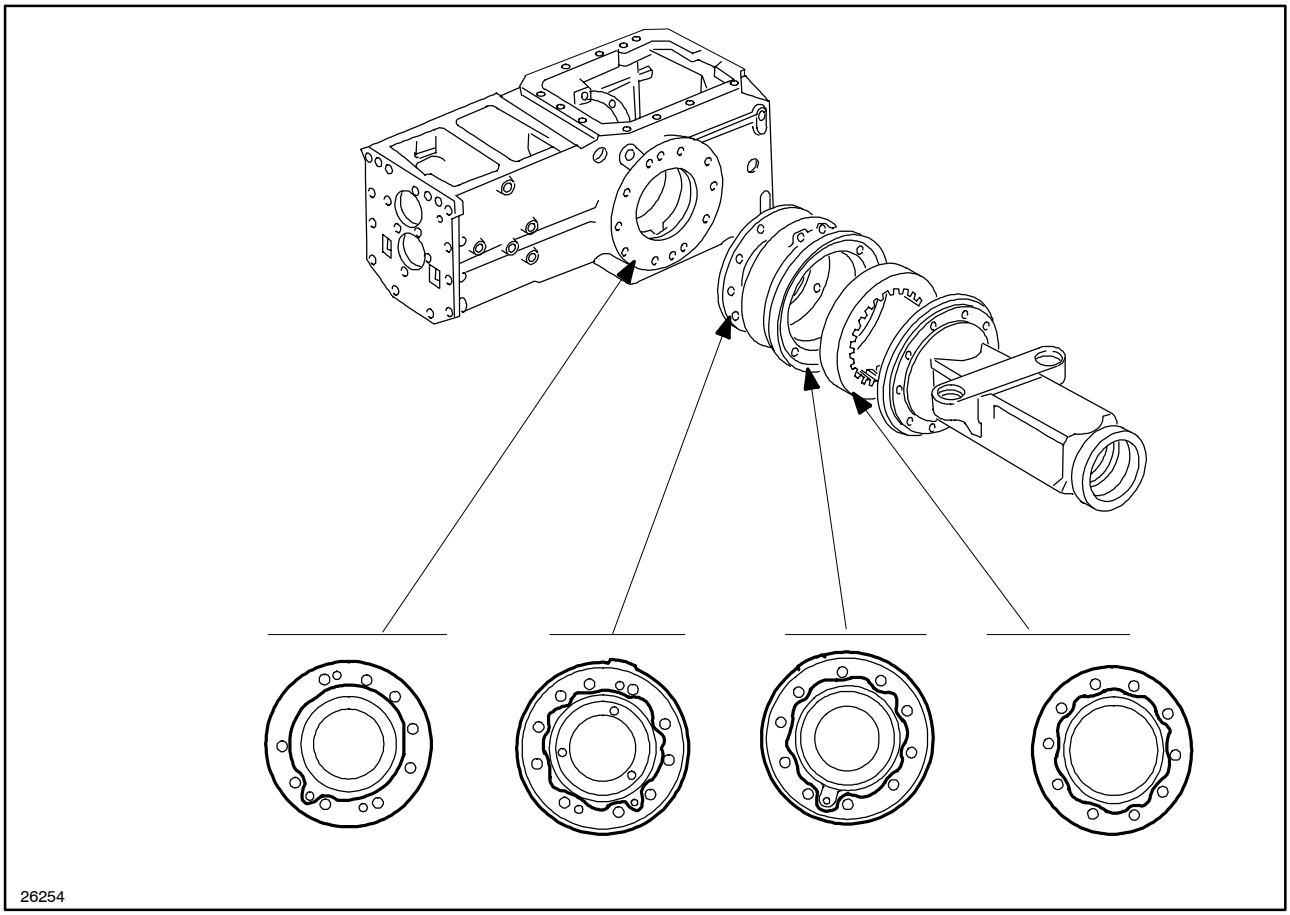


38

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

16. To refit the final drive casing to the rear transmission casing, proceed as follows:
- Refer to the illustrations in fig. 2 for the positioning of the various parts.
- Before reassembling the final drive casing to the rear transmission casing, carefully clean and degrease the mating surfaces, then apply sealing compound [approx. 0.0787 in. (2 mm)] along the marked line shown in the drawing 39.
- Check the seals and replace if damaged.
- Apply the torque settings listed on page 2.
- Insert the wear disk, rotate the union and refit the differential lock line.
- Fit the brake disk, spacer and crown gear.
- Connect the service brake lines.
- Using tools suitable equipment for retaining and lifting, refit the final drive together with differential shaft and rear reflector.
- Fit the cab support rear bracket retaining bolts.
- Remove the wooden block from between the cab and lift body.
- Tighten the bolt securing the cab to the left-hand rear support.
- Assemble the window washer tank.
- Fit the LH wheel.
- Fit the anti-swing rod and the vertical tie-rod.
- Remove the fixed stands.
- Screw the oil drain plug and replenish (for the quantity and prescribed product see Sect. 00).
- Connect the battery negative lead.
- Bleed the brakes.



39

Diagram of seal compound application for brake assembly and lateral final drives on the transmission gearbox.

The types of sealing compounds to be applied are specified in Section 00.

SECTION 35 - HYDRAULIC SYSTEMS

Chapter 1 - Rear mechanical hydraulic lift

CONTENTS

Operation	Description	Page
	Data	2
	Tightening Torques	7
	Tools	9
	Cross-sectional views	10
	Description and Operation	12
	Fault diagnosis	16
35 104 30	Rear lift oil pump D.A.	18
35 108 16	Lift-O-Matic control D.A.	20
35 110 08	Rear lift linkage adjustments	21
35 110 17	Rear lift external controls D.A. and adjustments	24
35 110 30	Rear lift R.I.	25
35 110 40	Rear hydraulic lift internal controls D.A. and adjustments	32
35 110 42	Arm shaft and lifting cylinder D.A.	32
35 110 46	Lift shaft bushings - Replacement	32
35 114 10	Lift control valve R.I.	43
35 114 14	Lift control valve D.A.	45
35 114 30	Lift pressure relief valve R.I.	50
35 114 32	Lift pressure relief valve - Setting	50

REAR MECHANICAL HYDRAULIC LIFT DATA

Type		with controlled position/draft and mixed control
Operating		by means of two independent levers
Setting speed of lift reaction		automatic, by means of hydraulic device integral to control valve
LIFT-O-MATIC		allows fast lifting/lowering operations using push buttons, without using the draft control position levers
Single-acting cylinder:		
- rated diameter and stroke:		
Models TL70, TL80, TL90 and TL100	in. (mm)	4.3307 x 5.0393 (110 x 128)
- capacity:		
Models TL70, TL80, TL90 and TL100	cm^3	1216
Pressure relief valve setting	psi (bar)	2755.86 to 2828.38 (190 to 195)
Cylinder safety valve setting	psi (bar)	3045.95 to 3118.47 (210 to 215)
Lift piston diameter:		
- Models TL70, TL80, TL90 and TL100	in. (mm)	4.3299 to 4.3307 (109.980 to 110.000)
Internal diameter of cylinder liner:		
- TL70, TL80, TL90 and TL100	in. (mm)	4.3321 to 4.3335 (110.036 to 110.071)
Clearance between piston and liner	in. (mm)	0.0014 to 0.0035 (0.036 to 0.091)
Diameter of lift arms shaft (11, fig. 3) in correspondence with bushes:		
- right-hand side	in. (mm)	2.2035 to 2.1653 (55.970 to 55.000)
- left-hand side	in. (mm)	2.4673 to 2.4685 (62.670 to 62.700)
Internal diameter of bushings fitted on lift body:		
- right-hand side (8)	in. (mm)	2.1692 to 2.1725 (55.100 to 55.184) ([1])
- left-hand side (12)	in. (mm)	2.4724 to 2.4757 (62.800 to 62.884) ([1])
Clearance between lift arm shaft and bushings	in. (mm)	0.0039 to 0.0084 (0.100 to 0.214)
Interference between bushings and relative seats	in. (mm)	0.0025 to 0.0072 (0.065 to 0.185)
Axial clearance of shaft complete with lift arms	in. (mm)	0.0078 to 0.0551 (0.2 to 1.4)

([1]) Value to be obtained after obtaining interference fit without grinding operations.

(continued)

REAR MECHANICAL HYDRAULIC LIFT DATA

(cont)

External diameter of draft control idler shaft	in. (mm)	0.8648 to 0.8661 (21.967 to 22.000)
Internal diameter of seats in support	in. (mm)	0.8669 to 0.8689 (22.020 to 22.072)
Clearance between idler shaft and its seat	in. (mm)	0.0007 to 0.0041 (0.020 to 0.105)
Diameter of position control idler shaft	in. (mm)	0.5501 to 0.5511 (13.973 to 14.000)
Internal diameter of position control idler shaft	in. (mm)	0.5518 to 0.5535 (14.016 to 14.059)
Clearance between draft control idler shaft and position control idler shaft	in. (mm)	0.0006 to 0.0003 (0.016 to 0.086)
Clearance between control valve block pin (8, fig. 4) and the relative seat on the control valve block body	in. (mm)	0.0003 to 0.0004 (0.008 to 0.012) ([2])
Clearance between lift control valve (10) and the relative seat on the control valve block body	in. (mm)	0.0003 to 0.0005 (0.008 to 0.014) ([2])
Check valve return spring (12):		
- spring free length	in. (mm)	1.0039 (25.5)
- spring length under load of 52 to 56 N (5.28 to 5.72 kg)	in. (mm)	0.6889 (17.5)
Control valve block pin return spring (5):		
- spring free length	in. (mm)	1.9881 (50.5)
- spring length under load of 31.7 to 35 N (3.23 to 3.57 kg)	in. (mm)	1.3385 (34)
Control valve return spring (9)		
- spring free length	in. (mm)	1.7322 (44)
- spring length under load of 103 to114.7 N (10.5 to 11.7 kg)	in. (mm)	1.1417 (29)
Arm descent speed control valve spring (14)		
- spring free length	in. (mm)	1.3385 (34)
- spring length under load of 67 to 73 N (6.86 to 7.46 kg)	in. (mm)	1.0629 (27)
Intervention speed control valve spring (1):		
- spring free length	in. (mm)	1.8897 (48)
- spring length under load of 65 to 71 N (6.86 to 7.2 kg)	in. (mm)	1.2598 (32)
Intervention speed control valve spring (4):		
- spring free length	in. (mm)	0.8267 (21)
- spring length under load of 0.9 to1 N (0.09 to 0.11 kg)	in. (mm)	0.5118 (13)

([2]) During assembly the control valve block pins and control valves are carefully selected so as to obtain the required clearance.

IMPLEMENT HITCHING DEVICE DATA

Type		three-point linkage
Category:		
- Models TL70, TL80, TL90 e TL100		2[a]
Draft control		by means of lower arms with flex bar
Maximum lifting load with vertical arm links pivoted in the rear hole on the horizontal arms and three-point linkage connected to upper hole on top link:		
- at link ends of horizontal arms:	lbs. (kg)	7363.43 (3340)
- Models TL70 and TL80 (with an additional jack)	lbs. (kg)	9810.57 (4450)
- Models TL90 and TL100 (with two additional jacks)	lbs. (kg)	11155.39 (5060)
- with centre of gravity at 610 mm from link ends:	lbs. (kg)	7076.83 (3210)
- Models TL70 and TL80 (with an additional jack)	lbs. (kg)	8168.12 (3705)
- Models TL90 and TL100 (with two additional jacks)	lbs. (kg)	8961.79 (4065)
Flex bar diameter:		
- Models TL70, TL80 and TL90	in. (mm)	0.9790 to 0.9803 (24.867 to 24.900)
- model TL100	in. (mm)	1.0185 to 1.0236 (25.870 to 26.000)
- model TL100 (in correspondence with the bushings)	in. (mm)	1.1798 to 1.1811 (29.967 to 30.000)
End float of flex bar	in. (mm)	0.0748 to 0.1771 (1.9 to 4.5)

DATA OF HYDRAULIC PUMP C31 (MODELS TL70)

Filter		
Type		paper cartridge
Location		fixed to the pump housing on suction side
Pump		
Type		gear type with oil suction from transmission casing
Location		to the rear of the timing cover
Model		C31
Construction		CNH
Operating		by means of the timing gears
Direction of rotation (as seen from drive side)		clockwise
Engine speed to pump speed ratio		1 : 0.931
Maximum speed of rotation (with engine at maximum power)	rpm	2328
Corresponding rated output	dm^3/min (l/min)	34.5

(continued)

DATA OF HYDRAULIC PUMP C31 (MODELS TL70)

(cont)

Flow rate on workbench at 1450 rpm and pressure at 2219.19 psi (153 bar):		
- for new or overhauled pump	dm^3/min (l/min)	20
- for worn pump	dm^3/min (l/min)	14
- test oil temperature	F° (C°)	131 to 149 (55 to 65)
- test oil viscosity		SAE 20
Driven and driving gear shaft diameter	in. (mm)	0.6850 to 0.6857 (17.400 to 17.418)
Internal diameter of seats in supports	in. (mm)	0.6870 to 0.6877 (17.450 to 17.470)
Clearance between gear shafts and their seats	in. (mm)	0.0012 to 0.0027 (0.032 to 0.070)
- maximum clearance due to wear	in. (mm)	0.0039 (0.1)
Radial clearance of gears in pump body	in. (mm)	0.0007 to 0.0026 (0.020 to 0.064)
Maximum wear on pump body, suction side, at position of gears	in. (mm)	0.0039 (0.1)
Width of gears (5, fig. 9)	in. (mm)	0.9448 to 0.9454 (24.000 to 24.015)
Width of supports (4 and 6)	in. (mm)	0.9641 to 0.9649 (24.490 to 24.510)
Width of pump body (3) for gear seats and supports	in. (mm)	2.8793 to 2.8803 (73.135 to 73.160)
End float of gears complete with supports in pump body (recondition if necessary)	in. (mm)	0.0039 to 0.0070 (0.100 to 0.180)

DATA OF HYDRAULIC PUMP C42 (MODELS TL80, TL90, TL100U) (OPTIONAL FOR MODELS TL70)

Filter		
Type		paper cartridge
Location		fixed to the pump body on suction side
Pump		
Type		gear type with oil suction from transmission casing
Location		to the rear of the timing cover
Model		C42
Construction		CNH
Operating		by means of the timing gears
Direction of rotation (as seen from drive side)		clockwise
Engine speed to pump speed ratio		1 : 0.931
Maximum speed of rotation (with engine at maximum power)	rpm	2328
Corresponding rated output	dm^3/min (l/min)	44.5
Flow rate on workbench at 1450 rpm and pressure at 2219.19 psi (153 bar):		
- for new or overhauled pump	dm^3/min (l/min)	25.8
- for worn pump	dm^3/min (l/min)	18
- test oil temperature	F° (C°)	131 to 149 (55 to 65)
- test oil viscosity		SAE 20

(continued)

DATA OF HYDRAULIC PUMP C42 (MODELS TL80, TL90, TL100) (OPTIONAL FOR MODELS TL70)

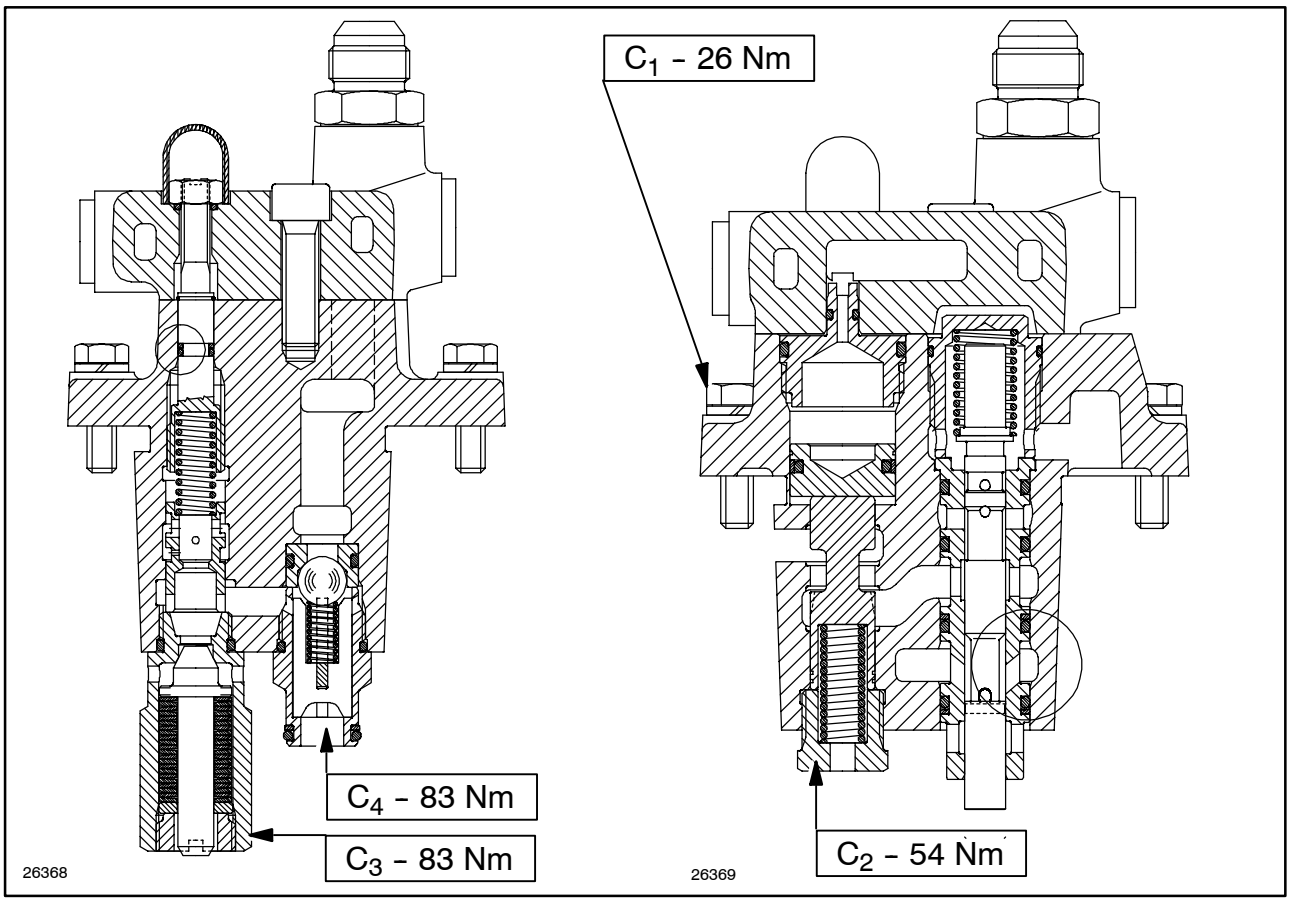
(cont)

Driven and driving gear shaft diameter	in. (mm)	0.6850 to 0.6857 (17.400 to 17.418)
Internal diameter of seats in supports	in. (mm)	0.6870 to 0.6879 (17.450 to 17.475)
Clearance between gear shafts and their seats	in. (mm)	0.0012 to 0.0029 (0.032 to 0.075)
- maximum clearance due to wear	in. (mm)	0.0039 (0.1)
Radial clearance of gears in pump body	in. (mm)	0.0007 to 0.0025 (0.020 to 0.064)
Maximum wear on pump body, suction side, at position of gears	in. (mm)	0.0039 (0.1)
Width of gears (5, fig. 9)	in. (mm)	1.2125 to 1.2131 (30.800 to 30.815)
Width of supports (4 and 6)	in. (mm)	0.9641 to 0.9649 (24.490 to 24.510)
Width of pump body (3) for gear seats and supports	in. (mm)	3.1470 to 3.1480 (79.935 to 79.960)
End float of gears complete with supports in pump body (recondition if necessary	in. (mm)	0.0039 to 0.0070 (0.100 to 0.180)

BOSCH OR SAUER HYDRAULIC PUMP DATA (OPTIONAL FOR MODELS TL70, TL80, TL90, TL100)

Filter		
Type		paper cartridge
Location		fixed to the pump housing on suction side
Pump		
Type		gear type with oil suction from transmission casing
Location		to the rear of the timing cover
Bosch model		0 510 725 085
Sauer model		550/1/34385
Operating		by means of the timing gears
Direction of rotation (as seen from drive side)		clockwise
Engine speed to pump speed ratio		1 : 0.931
Maximum speed of rotation (with engine at maximum power)	rpm	2328
Corresponding rated output	dm^3/min (l/min)	60
Flow rate on workbench at 1450 rpm and pressure at 153 bar (156 kg/cm^2):		
- for new or overhauled pump	dm^3/min (l/min)	34.6
- for worn pump	dm^3/min (l/min)	24.3
- test oil temperature	F° (C°)	131 to 149 (55 to 65)
- test oil viscosity		SAE 20

TIGHTENING TORQUES

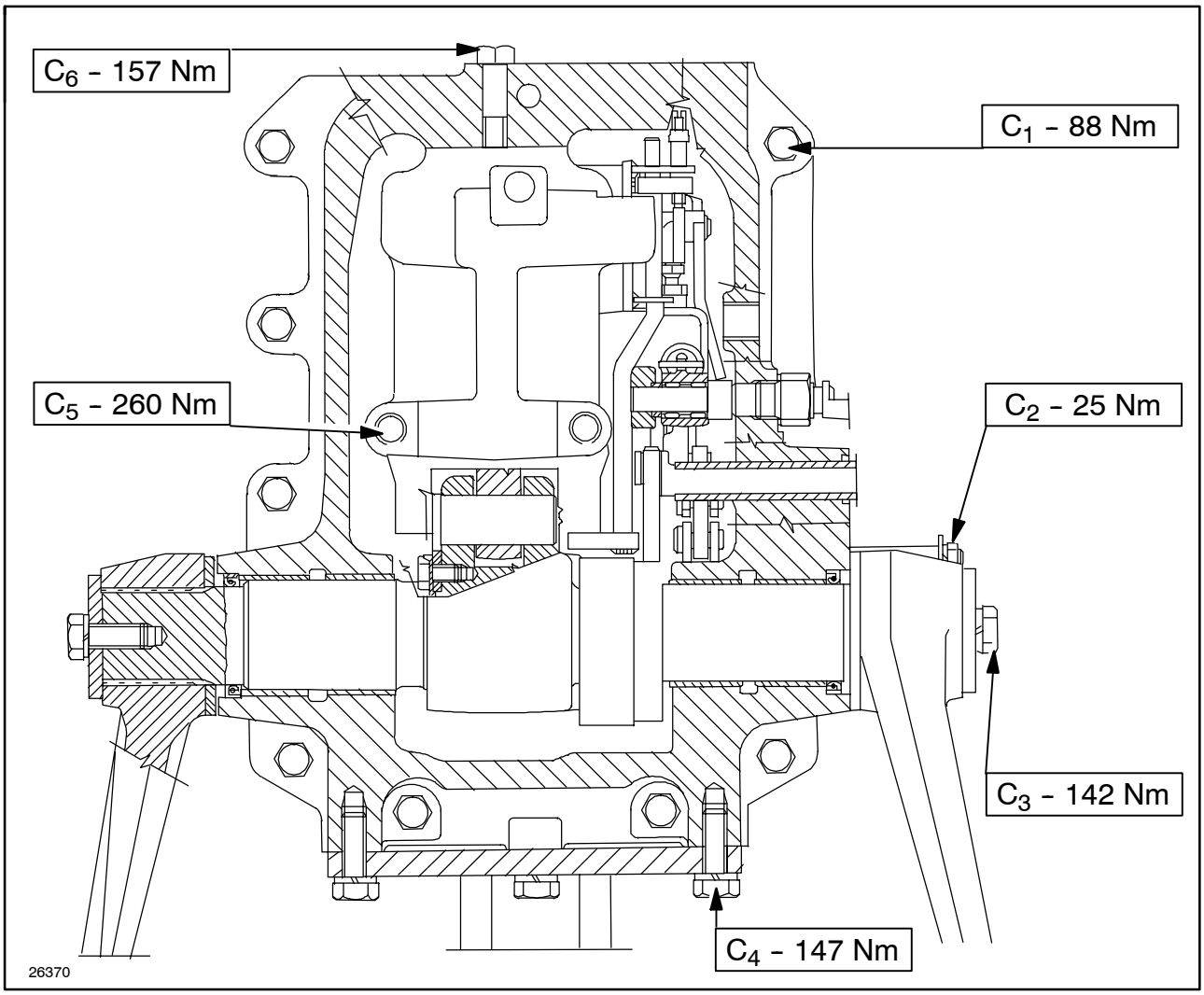


1

TIGHTENING TORQUES	Thread	Tightening torque	
		Nm	kgm
Lift			
Bolts securing control valve block to lift (C_1, fig. 1)	M 8 x 1.25	26	2.7
Control valve cap (C_2)	M 20 x 1.5	54	5.5
Cylinder safety valve (C_3)	M 20 x 1.5	83	8.5
Check valve union (C_4)	M 24 x 1.5	83	8.5
Inner lift arm securing bolts	M 10 x 1.25	61	6.2
Position shaft nut	M 10 x 1.25	14.7	1.5
Implement hitching device			
Flex bar support retaining bolts	M 16 x 1.5	221	22.5
Lateral stabiliser strut support retaining bolts	M 16 x 1.5	221	22.5
Pick-up hitch hook support retaining bolts	M 16 x 1.5	221	22.5

(continued)

TIGHTENING TORQUES



2

(cont)

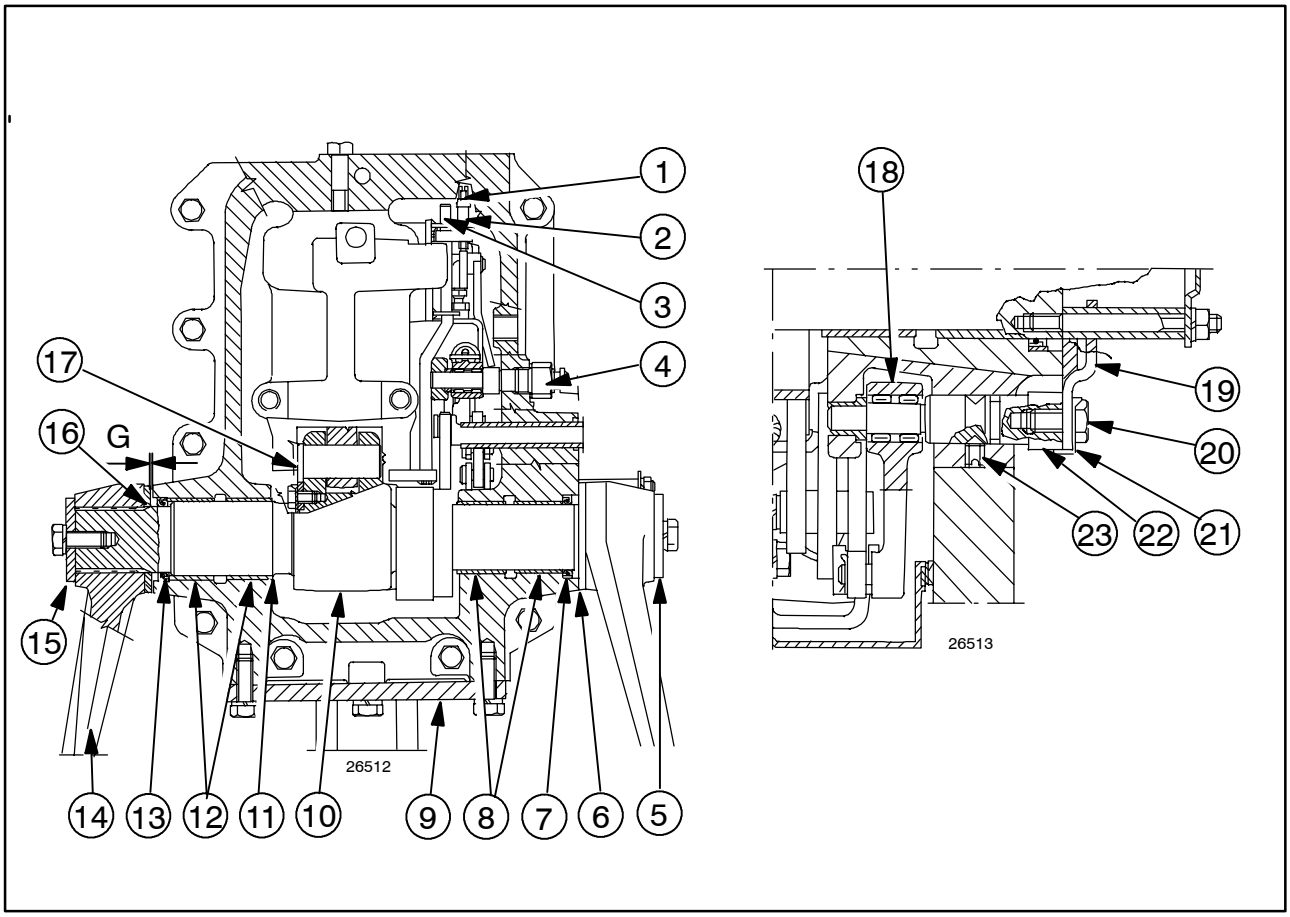
TIGHTENING TORQUES	Thread	Tightening torque	
		Nm	kgm
Bolts securing lift to rear transmission casing (C_1, fig. 2)	M 12 x 1.25	98	10
Nuts for lever quadrant bracket stud bolts (C_2)	M 8 x 1.25	25	2.6
Lifting arm plate retaining bolts (C_3)	M 14 x 1.5	142	14.5
Three-point linkage support retaining bolts (C_4)	M 14 x 1.5	147	15
Lift cylinder retaining bolts:			
- top (C_5)	M 16 x 1.5	260	26.5
- front (C_6)	M 14 x 1.5	157	16

HYDRAULIC LIFT TOOLS

WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**.
To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

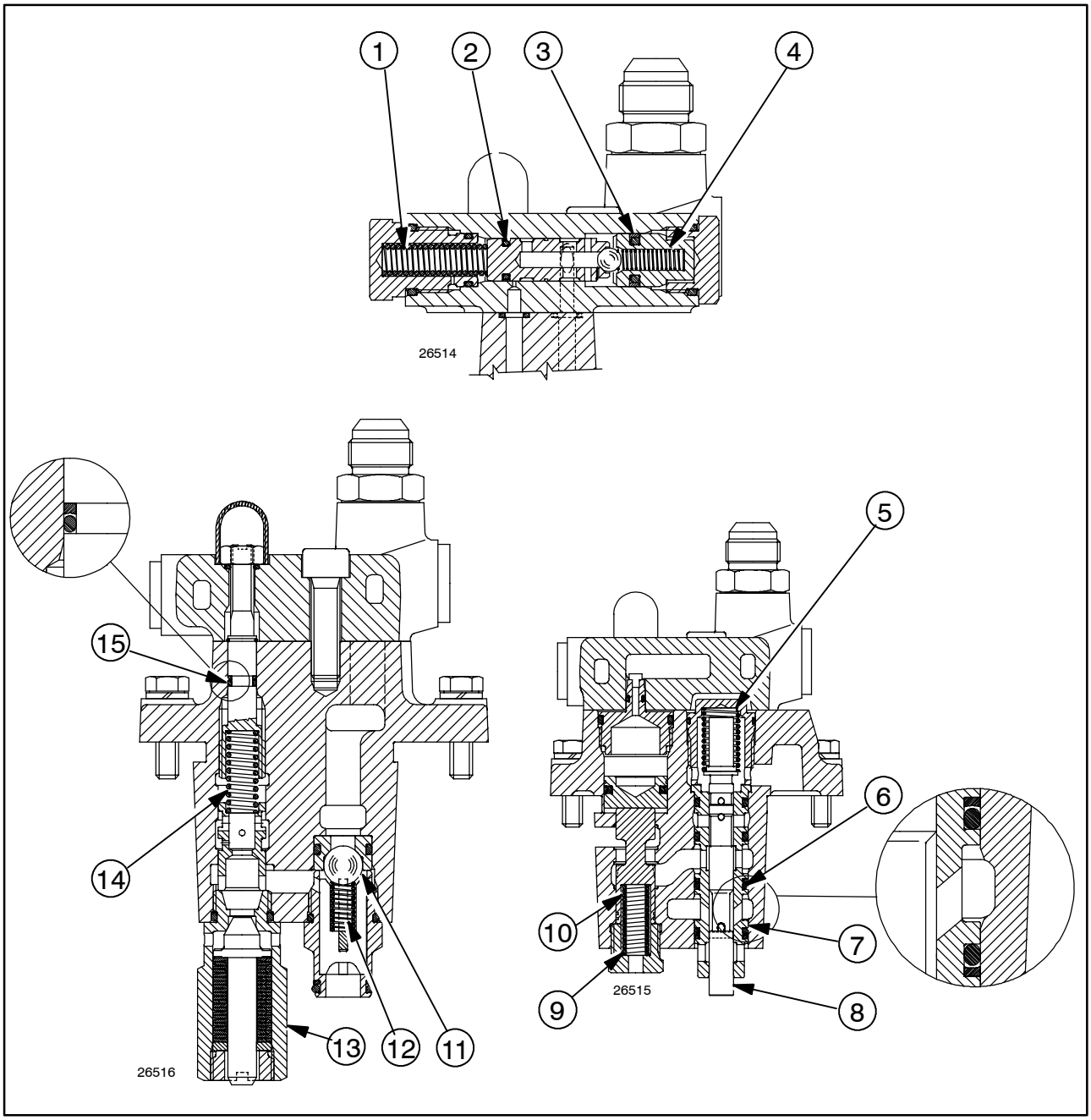
	380000224	Hydraulic lift lifting hook.
X	**380000225**	Ring for fitting piston with lift seals (Models TL70, TL80, TL90 and TL100).
X	**380000262**	Punch for fitting lift arm shaft seal.
X	**380000261**	Punch for fitting needle bearings on control valve block control lever bushing.
X	**380000260**	Punch for fitting needle bearings to lower draft control lever and to draft control link rod.
X	**380000230**	Wrench for cylinder safety valve setting ring nut.
X	**380000231**	Wrench for lift pressure relief setting ring nut.
X	**380000266**	Protection device for fitting seal on arm descent speed control pin.
	380000240	Universal pressure control kit.
	380000215	Hand pump for valve calibration.
X	**380000218**	Union for cylinder safety valve calibration.
X	**380000217**	Union for lift pressure relief valve calibration.
X	**380000274**	Union for checking control valve seal.
X	**380000267**	Wrench for arm height adjustment.
X	**380000275**	Guard for pilot valve seal.
X	**380000263**	Controlled draft setting tool.
X	**380000264**	Position and draft control setting tool.
	380000238	Adapter (use with **380000224**).



3

Lift cross-sectional views

G. 0.0078 to 0.0551 in. (0.2 to 1.4 mm). Shaft end float.
1. Travel limit adjuster screw.
2. Sunken locknut for travel limit adjuster screw.
3. Travel limit shift rail.
4. Lift-O-Matic control valve tie-rod arm pin-lever.
5. Arm thrust plate.
6. Thrust washer.
7. Right-hand seal.
8. Right-hand bushing.
9. Top link support.
10. Internal arm.
11. Arm control shaft.
12. Left-hand bushings.
13. Left-hand seal.
14. Lift Arms.
15. Arm thrust plate.
16. Thrust washer.
17. Top link piston pin.
18. Draft control internal lever.
19. Bracket.
20. Retaining bolt.
21. Lock washer.
22. Lever pivot eccentric pin (18).
23. Threaded grub screw.



4

Hydraulic lift control valve block cross-sectional views

1. Intervention speed adjustment valve spring.
2. Seal and ring.
3. Seal and ring.
4. Intervention speed adjustment valve spring.
5. Control valve block pin return spring.
6. Seal and ring.
7. Control valve block pin seat.
8. Control valve block pin.
9. Control valve return spring.
10. Control valve.
11. Check valve ball.
12. Check valve return spring.
13. Cylinder safety valve.
14. Arm descent speed control valve spring.
15. Seal and ring.

NOTE: *When fitting seals 2, 3, 6 and 15, heat the corresponding support disks in oil at a temperature of approximately 122 °F (50 °C). When fitting seal (15) and its support disk, use protection device* ***380000266****. When fitting seal (6) and its support disks, use protection device* ***380000275****.*
The seals (2 and 3) and the supporting disks can be fitted without any protection, only taking the due precautions so as not to damage them.

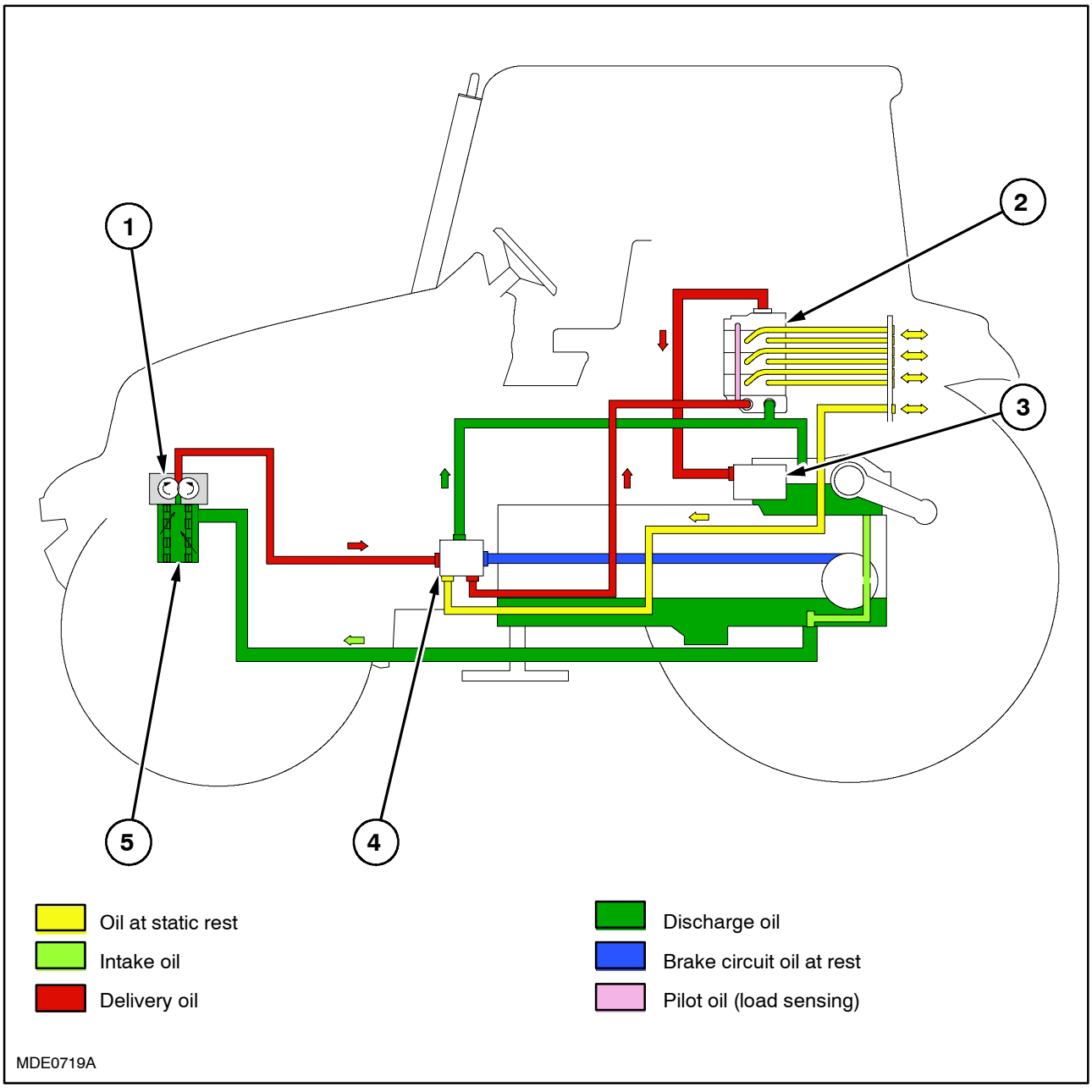
DESCRIPTION AND OPERATION

The mechanical lift can operate with controlled position and draft, and with mixed control.

The lift is controlled by two special levers located on the operator's right-hand side. It also features the Lift-O-Matic device which raises and lowers the implement without having to use the position and draft control levers.

Draft control is performed by the flex bar, positioned in the casing mounted under the rear transmission.

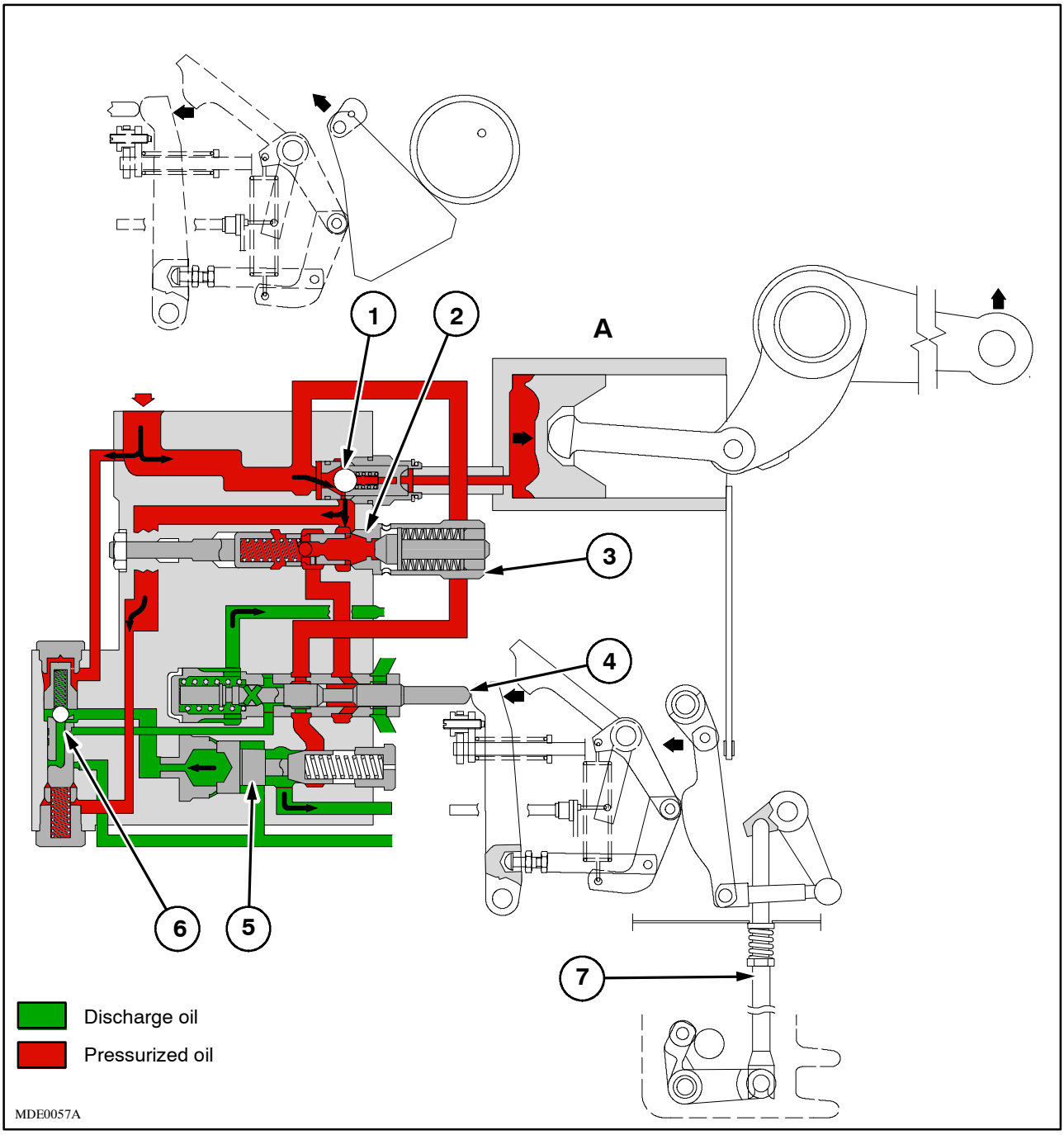
The lower lift arms and corresponding control rods are connected to the flex bar.



5

HYDRAULIC LIFT CIRCUIT

1. Hydraulic pump.
2. Auxiliary control valves (with UNLOAD valve).
3. Lift hydraulic control valve.
4. Trailer brake valve.
5. Filter.



6

ARM LIFT PHASE

A. Detail of operation with draft control.

1. Non-return valve.

2. Arm descent speed control valve.

3. Cylinder safety valve.

4. Control valve block pin.

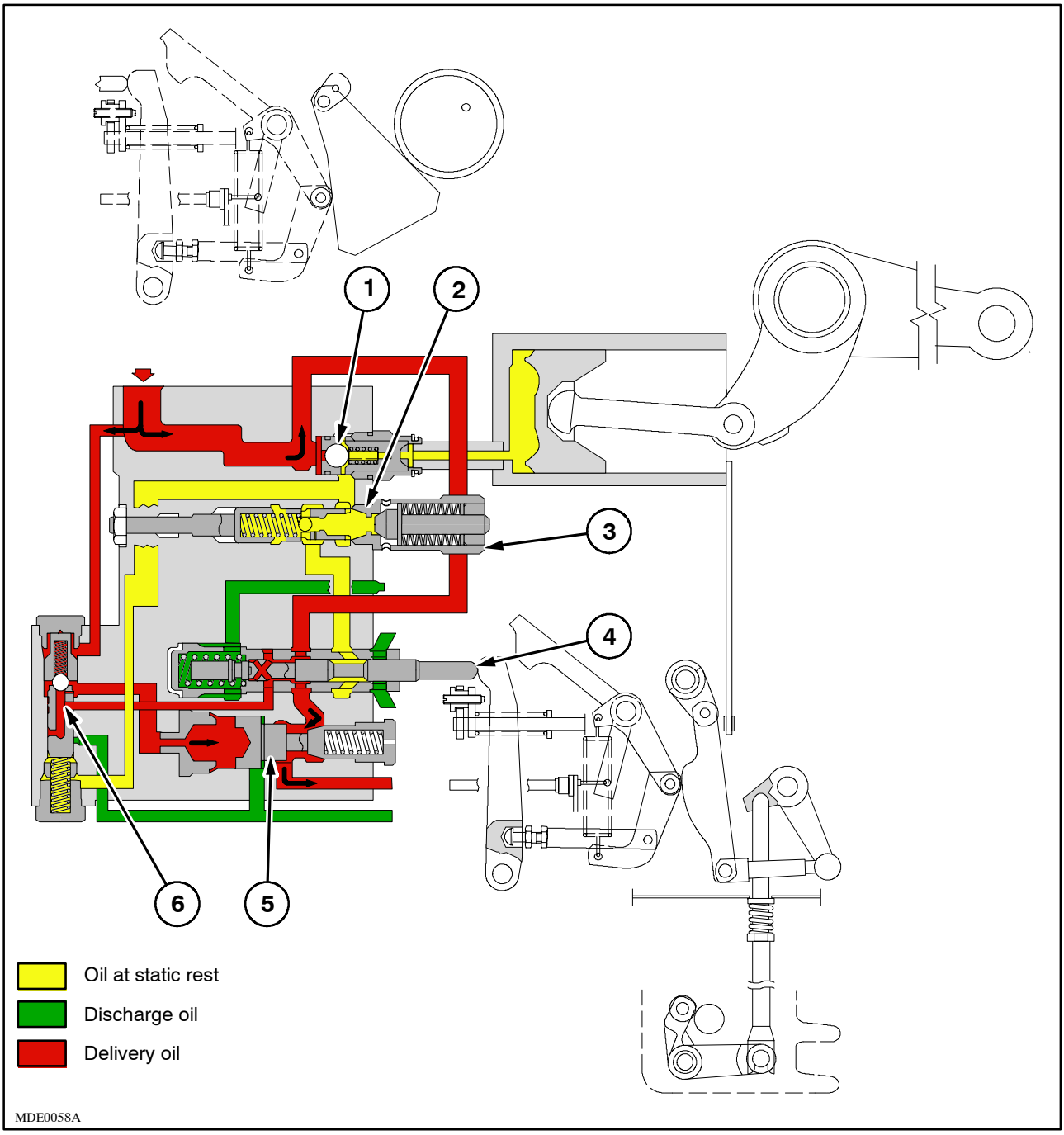
5. Control valve.

6. Intervention speed adjustment valve.

7. Draft transmission rod.

When the operator uses the position control lever (located on the right-hand side) to raise the arms, the internal lever mechanisms transmit the motion, shown by the arrows, to the control valve block pin (4). This pin interrupts the oil flow to the control valve (5). The valve (5) is moved by the relative spring, and the intervention speed valve (6), allowing the pressurised oil to open the check valve (1) and act on the arm raise piston.

With controlled draft operation (part **A**), the lift command is sent to the flex bar, which in turn transmits the movement (shown by the arrows) to the control valve block pin (4) via the transmission rod (7).



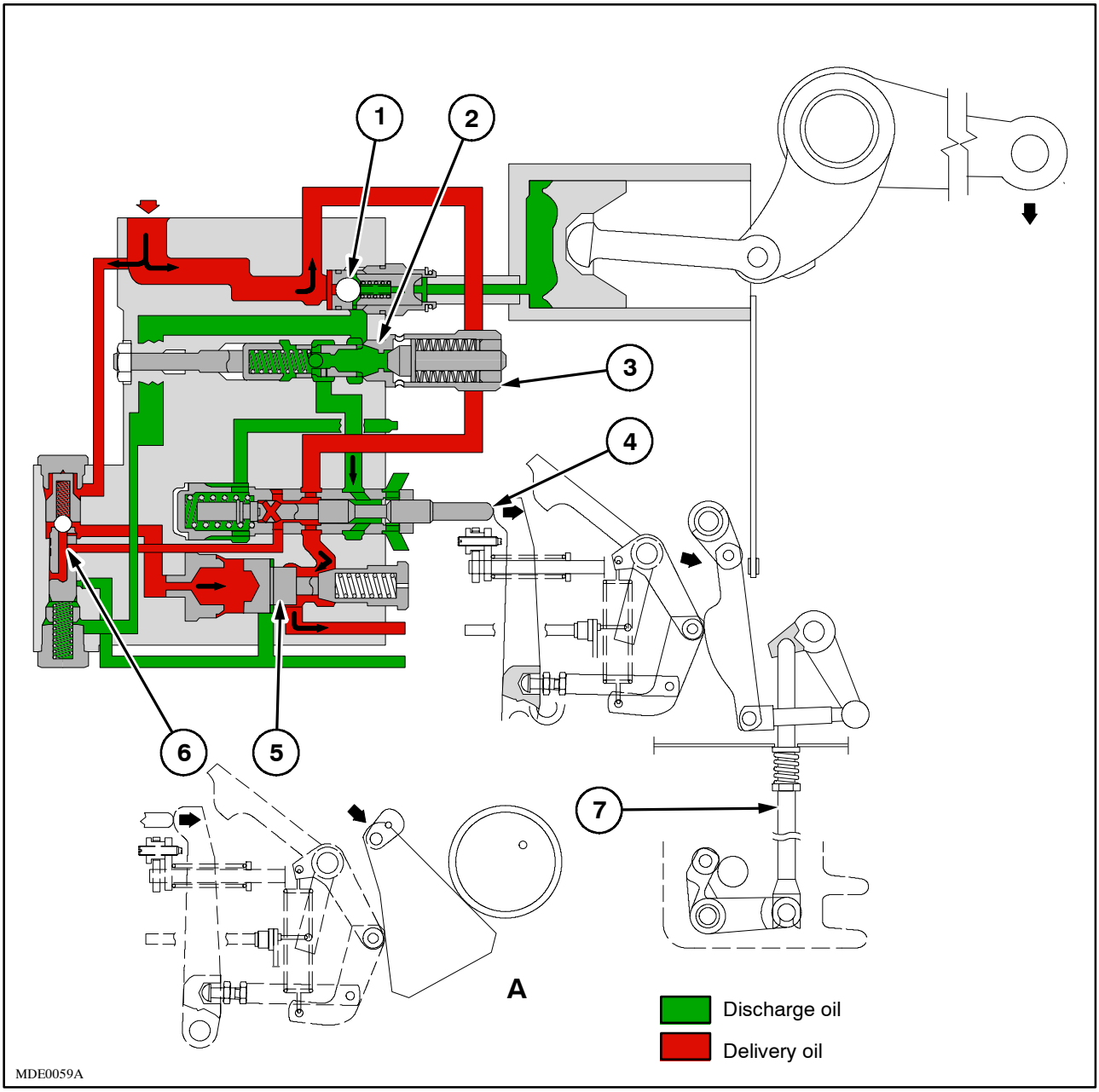
7

NEUTRAL PHASE

1. Non-return valve.
2. Arm descent speed control valve.
3. Cylinder safety valve.
4. Control valve block pin.
5. Control valve.
6. Intervention speed adjustment valve.

When the lift arms have reached the predetermined height, the internal lever mechanisms stop. The position of the control valve block pin (4), allows the oil to be directed to the control valve piston (5) through the intervention speed adjustment valve (6).

The pressurised piston moves the valve, overcoming the resistance of the spring and opening a drainage line, allowing the oil to flow to the transmission casing instead of the lift cylinder.



8

ARM LOWER PHASE

A. Detail of operation with draft control.
1. Non-return valve.
2. Arm descent speed control valve.
3. Cylinder safety valve.
4. Control valve block pin.
5. Control valve.
6. Intervention speed adjustment valve.
7. Draft transmission rod.

When the operator lowers the position control lever on the right-hand side, the arms are lowered. The internal lever mechanisms transmit movement (shown by the arrows) to the control valve block pin (4). The control valve block pin (4), is pulled downward by the spring, allowing the cylinder oil, under the thrust of the piston, to discharge through the arm descent speed control valve (2). The discharge oil passes through the valve (2) and pushes on the control valve piston (5). This overcomes the resistance of the spring and moves the valve, thereby creating an outlet and allowing the oil to flow to the transmission housing instead of the lift cylinder.

With controlled draft operation (part A), the lowering command is sent to the flex bar, which in turn transmits the movement (shown by the arrows) to the control valve block pin (4) via the transmission rod (7).

NOTE: *The lowering speed of the implement connected to the lift arms is controlled by the position of the arm descent speed control valve (2).*

Unscrewing *the valve (2) control screw reduces the size of the outlet between the valve and the control valve block body: the implement takes longer to come down.*

Fully *tightening the screw increases the size of the discharge opening and the implement lowers faster.*

HYDRAULIC LIFT TROUBLESHOOTING

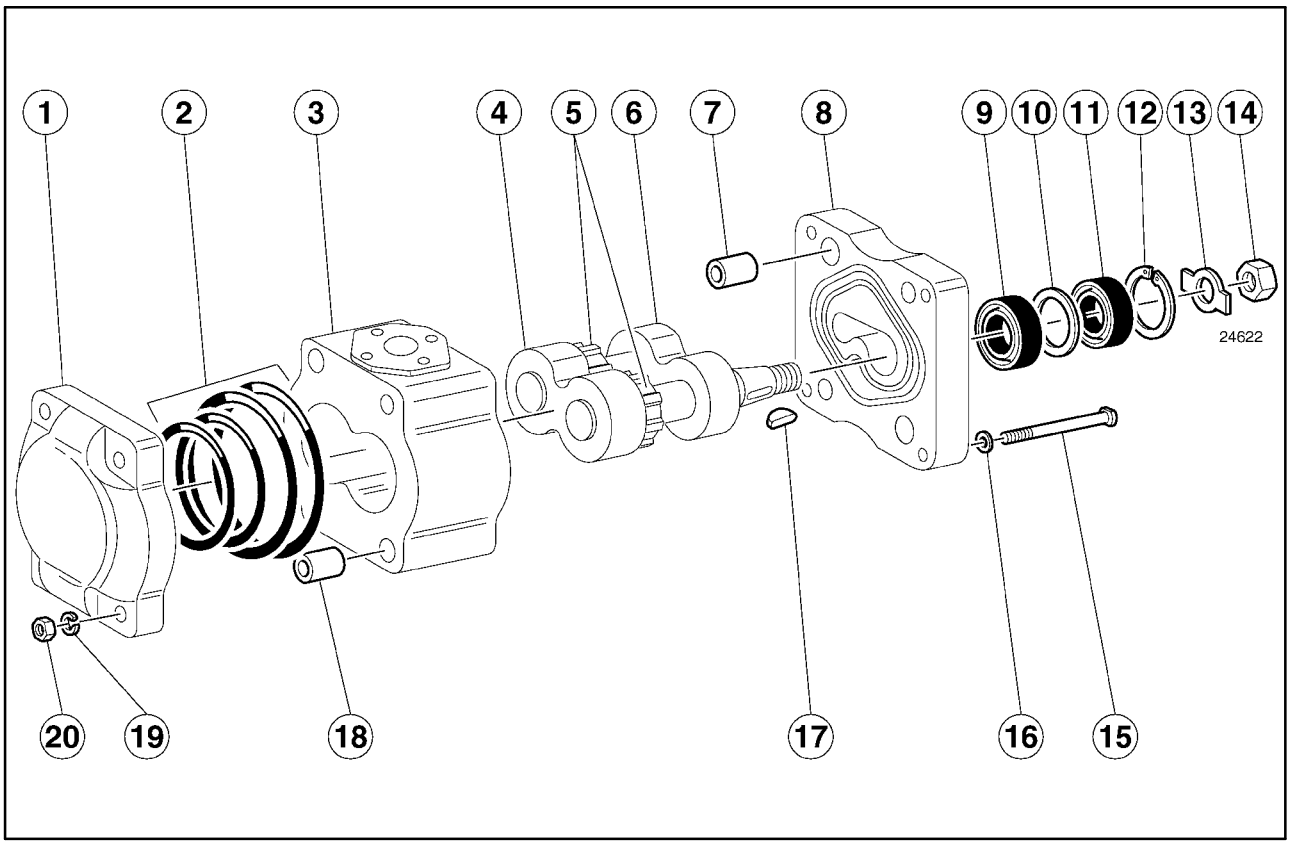
Problems	Possible Causes	Solutions
The lift does not raise.	1. Clogged oil filter.	Replace filter.
	2. Control valve jammed in discharge position.	Release control valve.
	3. Hydraulic pump faulty.	Overhaul or replace pump.
The lift moves in jerks.	1. Clogged oil filter.	Replace filter.
	2. Air in the pump suction line.	Check that the unions are airtight and the seals are efficient.
The lift rises too slowly.	1. Clogged oil filter.	Replace filter.
	2. Oil leaking past the seals resulting in pressure loss: piston seals or delivery union seals.	Replace all defective seals.
	3. Hydraulic pump faulty.	Overhaul or replace pump.
The lift lowers too slowly.	1. Arm descent speed set incorrectly.	Set correctly.
The lift lowers too quickly.	1. Arm descent speed set incorrectly.	Set correctly.
The lift operates in jerks.	1. Foreign bodies between the ball and relative seat on the delivery control valve.	Disassemble the valve, eliminate foreign bodies and check the oil filter.
	2. Faulty seal on the delivery control valve ball.	Replace the delivery control valve.
	3. Delivery control valve piston jammed.	Disassemble the valve and remove the cause of the piston jam.

(continued)

HYDRAULIC LIFT TROUBLESHOOTING

(cont)

Problems	Possible Causes	Solutions
The lift operates extremely slowly.	1. Blocked discharge holes on delivery control valve.	Disassemble the valve, eliminate the cause of the obstruction and check the oil filter.
	2. Delivery control valve piston jammed.	Disassemble the valve and remove the cause of the piston jam.
The lift is unable to keep the load raised (with the engine running, the load moves up and down rhythmically; with the engine turned off, the load lowers).	1. Faulty seal on check valve.	Dismantle, check and replace the parts concerned, if necessary.
	2. Oil leaking past the seals on the control valve block pin seat.	Replace seals.
	3. Control valve block pin seal faulty.	Dismantle and clean the seal; replace the control valve block pin and seat if defective.
	4. Oil leaking past the lift piston seal or the seals on the cylinder oil discharge fitting.	Replace seals.
	5. Defective seal or cylinder safety valve seal set to very low value.	Replace the valve.
The pressure relief valve cuts in when the lift arms reach the completely raised position.	1. Lift arm travel set incorrectly.	Set correctly.
Lift has poor lifting capacity.	1. The pressure relief valve is set incorrectly.	Replace the valve.
	2. Cylinder safety valve set incorrectly.	Replace the valve.
	3. Poor pump efficiency (generally combined with a considerable increase in lift time).	Overhaul or replace pump.



9

Hydraulic lift pump components

1. Front cover.
2. Cover seals.
3. Pump body.
4. Gear support.
5. Driven and driving gear shafts.
6. Gear support.
7. Bush.
8. Control side cover.
9. Driving shaft seal.
10. Spacer.
11. Driving shaft seal.
12. Circlip.
13. Lock washer.
14. Nut.
15. Screw.
16. Washer.
17. Tab.
18. Bush.
19. Lock washer.
20. Nut.

Op. 35 104 30
LIFT OIL PUMP Disassembly - Assembly with pump removed

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

Proceed as follows:

1. Remove the cover retaining nuts (20), bolts (15) and the relative safety washers.
2. Remove the nut (14) that fastens the sleeve to the pump driving shaft and the safety washer.
3. Remove the rear cover (8), the circlip (12) and the seals (9 and 11).
4. Mark the parts (3, 4, 5 and 6) in order to re-fit them in the same position, if in good condition.
5. Remove the supports (4 and 6) and the gears (5) from the rear cover (8) and the pump body (3).
6. Remove the seals (2) and the anti-extrusion rings.

Once the parts are removed, proceed as follows:

7. Check that the gear contact surfaces are flat and perpendicular to their supports. Interpose a thin layer of carbon black; small rough spots can be removed using extremely fine and adequately lubricated abrasive paper.

8. Check that the end float of the gear-support unit in the pump body is 0.0039 to 0.0070 in. (0.100 to 0.180 mm). The distance (2) must be 0.0039 to 0.0070 in. (0.100 to 0.180 mm) less than the distance(1).

If necessary, true the flat surfaces involved using lubricated abrasive paper to remove extremely small quantities of material.

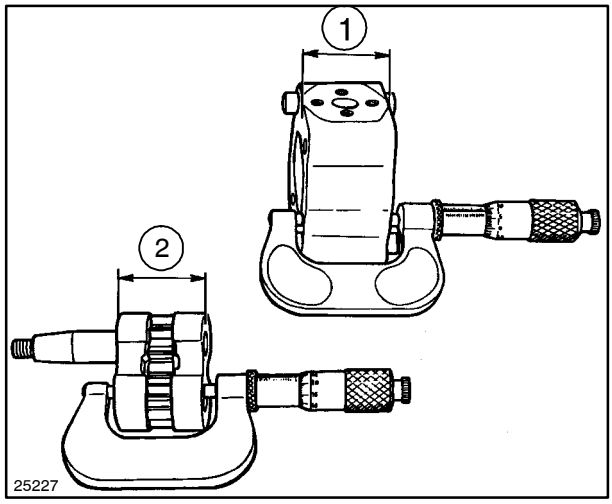
9. Clean all constituent parts thoroughly.

10. Replace seals (2, 9 and 11, fig. 9).

11. Lubricate the parts with the same oil used in the system and refit the pump, referring to fig. 9, and proceeding as follows:

12. to re-fit the pump carry out the above operations in reverse order starting from no. 6 to no. 1;

- always ensure maximum cleanliness to prevent foreign matter from entering and damaging the pump;
- fit together the previously marked parts (3, 4, 5 and 6, fig. 9), see op. 4, page 18, in their original positions;
- mount the gear supports (4 and 6 fig. 9) by hand in the pump body, positioning them with the unions on the external circumference in correspondence with the delivery line, and moving the front faces (milled for lubrication) flush with the gears;
- insert the plastic anti-extrusion rings on the seals (2, fig. 9);
- mount the seals (9 and 11, fig. 9), on the control side cover (8) with the relative spacer (10) facing towards the seal lips on the opposite spacer, then fill up with **AMBRA GR 9 grease**.



10

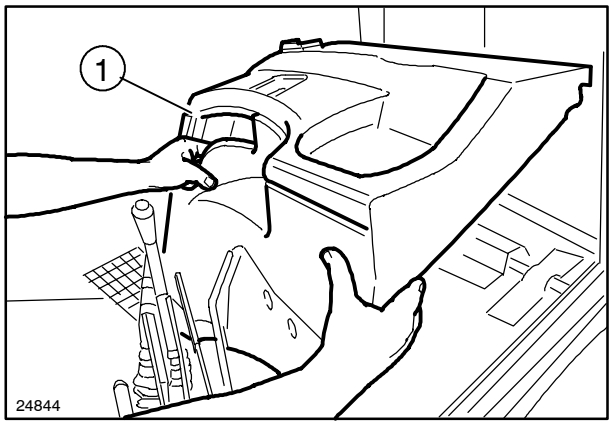
Op. 35 108 16
LIFT-O-MATIC CONTROL D.A.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

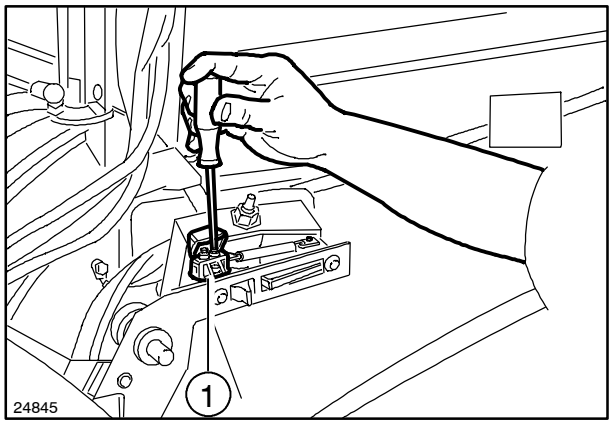
To remove the gearbox, proceed as follows:

1. Perform the disassembly sequences described in operation **90 160 42** for the **RH WALL FIXED PADDING** and remove all the padding.



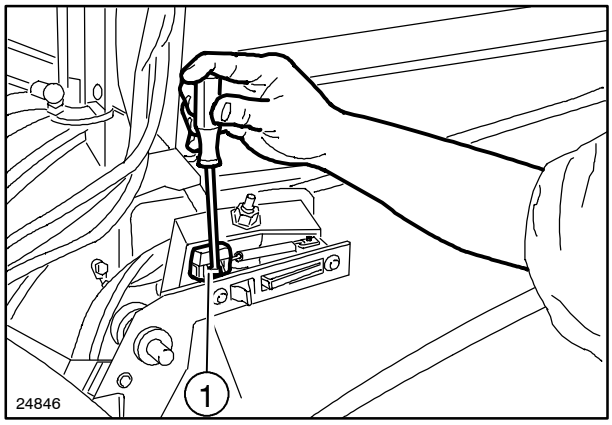
11

2. Disconnect the electrical connections on the lift-o-matic control unit (1).



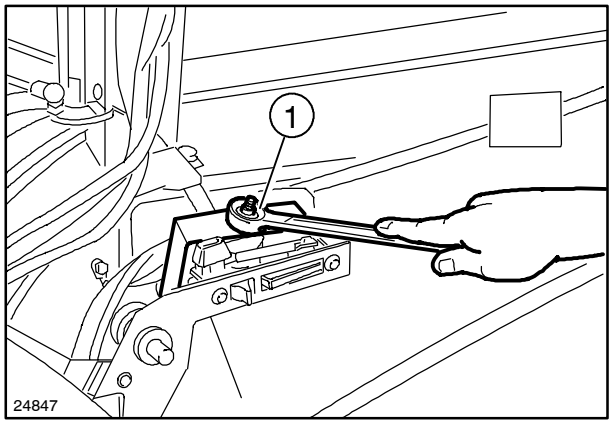
12

3. Unscrew the bolts securing the lift-o-matic switch (1).



13

4. Remove the ring nut (1) securing the PTO controls.
5. For assembly, perform the above operations in reverse order and fit all the rh padding, performing the assembly sequences described in operation **90 160 42** for the **RH WALL FIXED PADDING**.



14

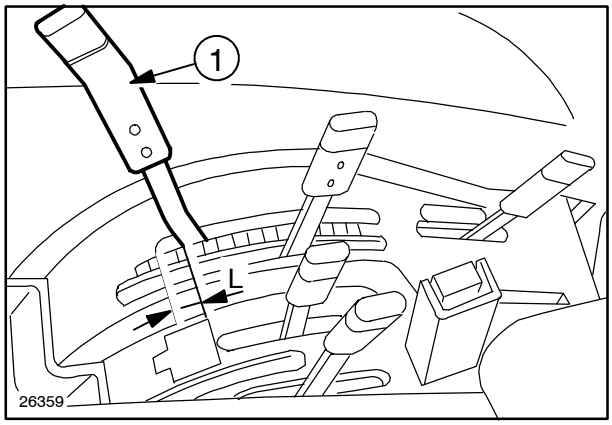
Op. 35 110 08
LINKAGE ADJUSTMENTS
Position control rod adjustments.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

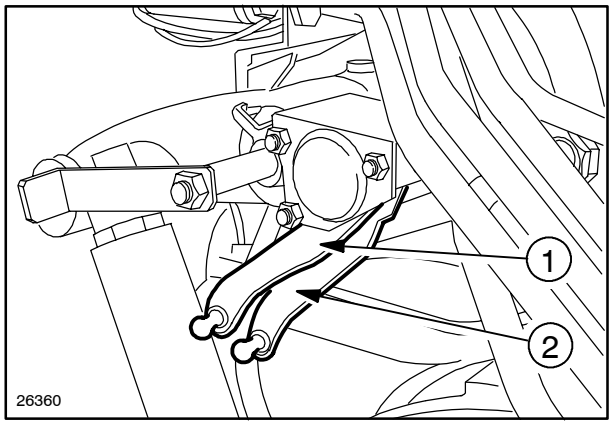
Proceed as follows.

1. Move the position control lever (1) forward completely on the quadrant and check that the distance (L) is 0.5905 to 0.7874 in (15 to 20 mm).



15

2. Move the external position control lever (1) completely back against the spacer.
3. Connect the control linkage and adjust its length if necessary.
4. Secure the rod in position using the locknuts.



16

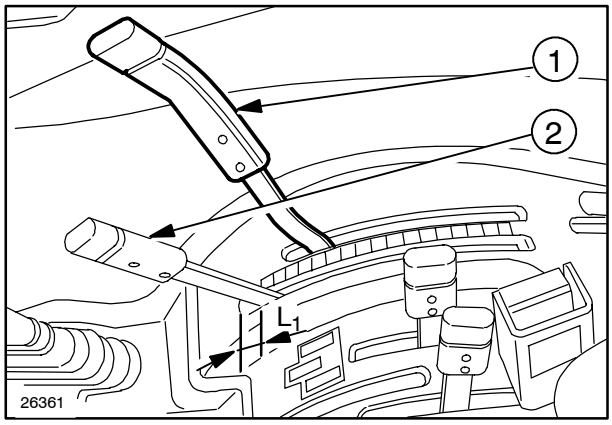
Draft control rod adjustments

Test conditions:

- engine running at medium speed;
- bring the oil in the system to a temperature of 86 to 104 °F (30 to 40 °C).

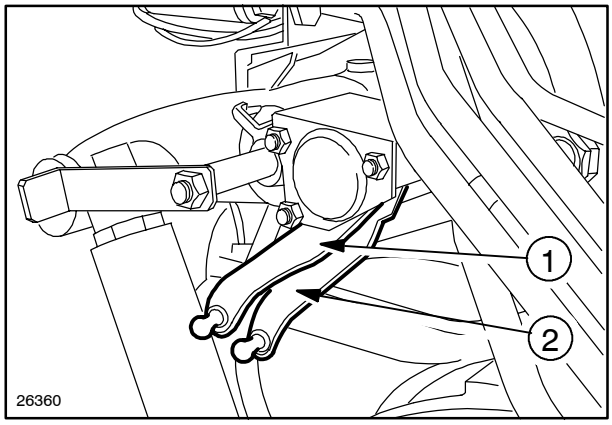
Then proceed as follows:

5. Move the position control lever (1) forward completely on the quadrant and the draft control lever (2) to a distance (L_1) of 0.5905 to 0.7874 in (15 to 20 mm) from the beginning of the slot.
6. Move the external draft control lever (2) completely back against the spacer.



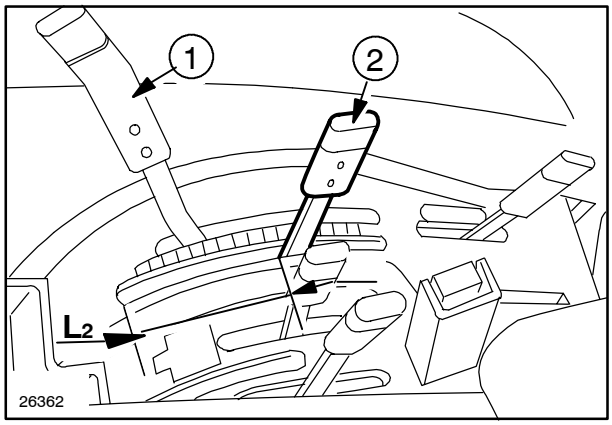
17

7. Connect the control linkage and adjust its length if necessary.



18

8. Move the draft control lever (2) to a distance (L_2) of 7.2834 to 7.6771 in. (185 to 195 mm) from the beginning of the slot and check that in this position the arms start to rise.
9. If the arms do not rise, adjust the eccentric pin (1, fig. 83) to reset this distance.
10. Secure the eccentric pin in position with the grub screw (1, fig. 84).

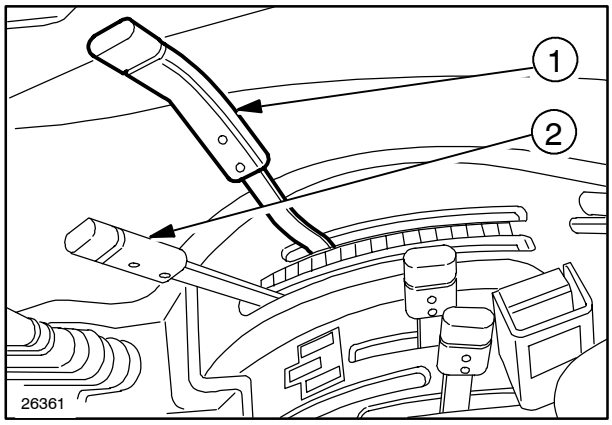


19

Adjusting LIFT-O-MATIC device

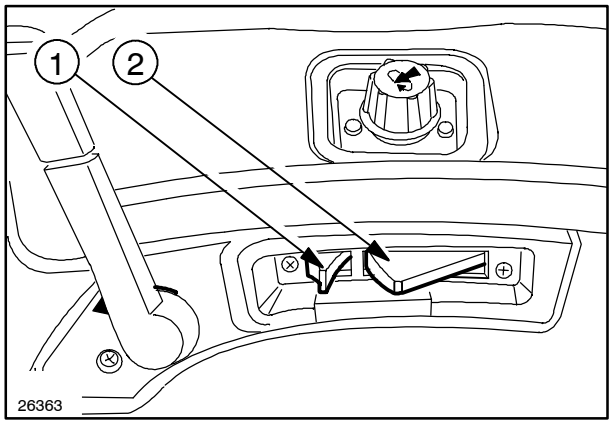
Proceed as follows.

11. Move the position control lever (1) and the draft control lever (2) completely forward on the quadrant.



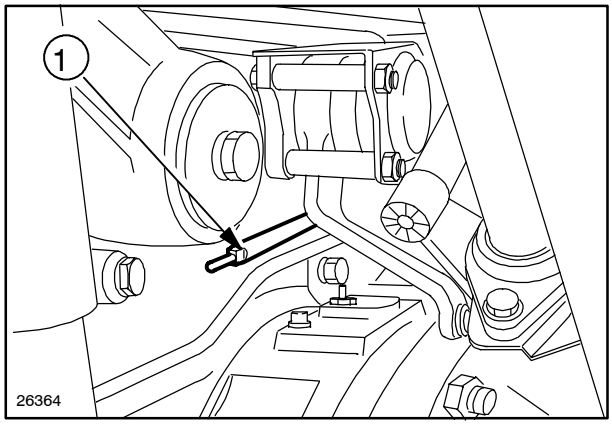
20

12. Raise the arms by means of the lever (1).



21

13. Tighten the nut (1) until the arms lower.
14. With the lever (1, fig. 21) in the same position, unscrew the nut (1) until the arms begin to rise.
15. Unscrew the nut (1) by another 1.5 turns.
16. Using the levers (1 and 2, fig. 21) lower and raise the arms a few times to ensure that the device is operating correctly.



22

OPERATIONS TO BE PERFORMED TO ADJUST THE UPPER STROKE LIMIT OF THE LIFT-O-MATIC DEVICE

CAUTION

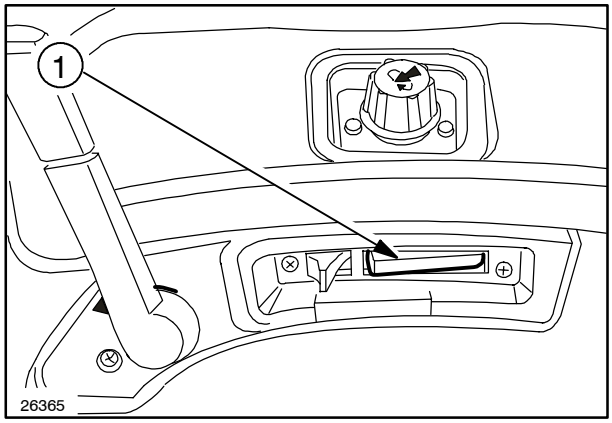
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

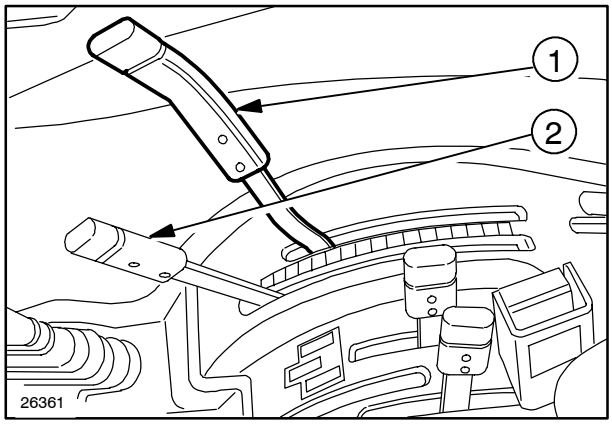
Proceed as follows:

1. Apply a load to the link ends of the lower implement attachment arms.
2. Start the engine and keep it running at medium speed.
3. Hold down the push-button (1) until the arms are in the attachment position (completely lowered).



23

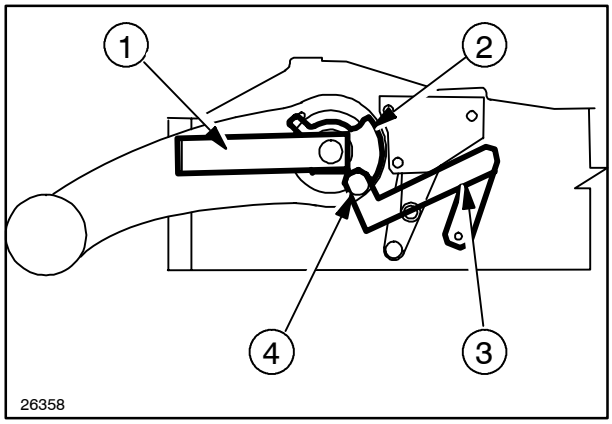
4. Move the levers (1 and 2) completely forward on the quadrant (completely lowered).
5. Using the position control lever (1) raise the arms to the desired height.



24

6. Slacken the lever (1) and turn the mobile sector (2) clockwise until it touches the needle (4) on the LIFT-O-MATIC control lever (3).
7. Use the LIFT-O-MATIC control buttons to raise and lower the arms a few times to ensure correct operation.

NOTE: *The arm upward stroke limit only applies to the LIFT - O - MATIC device and does not affect the other functions of the lift. This means that the arms can be raised completely using the control levers (1 and 2, fig. 24).*



25

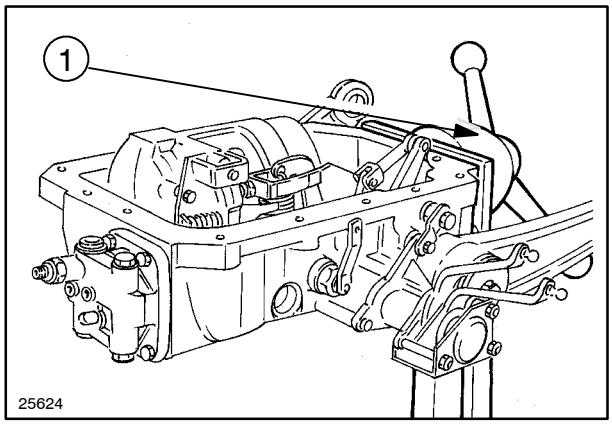
Op. 35 110 17
REAR LIFT EXTERNAL CONTROLS D.A.

DANGER

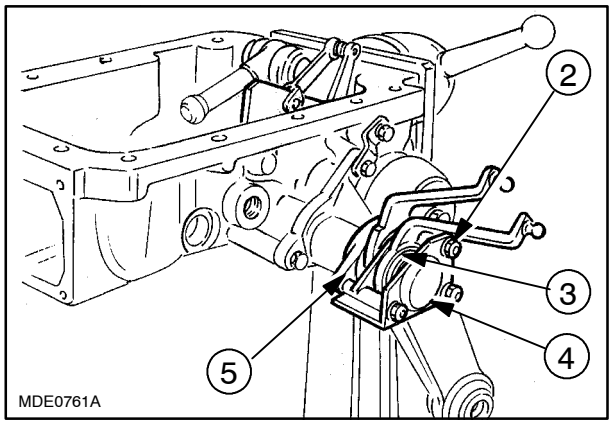
Lift and handle all heavy parts using suitable lifting equipment.
Make sure that the load is supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

Disassemble the external controls of the hydraulic lift as follows:

1. Position the hydraulic lift on a rotating stand (1, fig. 26).
2. Unscrew the nuts (2) and remove the spring and the retaining bracket (4).
3. Remove the circlip and extract the lever (3), friction disks, lever (5) and the stud bolts.



26



27

4. Unscrew the spacer retaining bolts (1) on the lever support (2).
5. To assemble, proceed as follows:

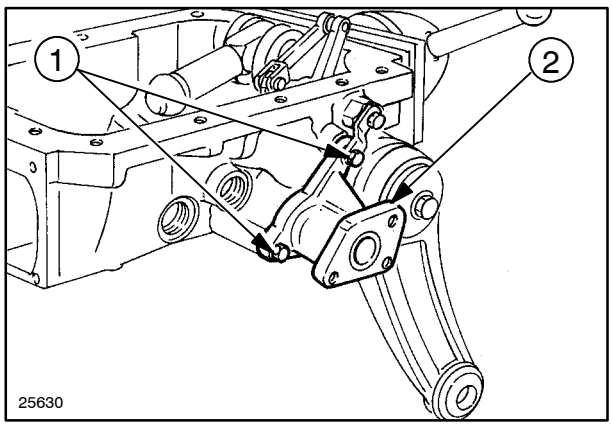
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Perform the above-described operations in reverse order for disassembly.

  Make the adjustments described on page 37.

NOTE: *The adjustments must be carried out in the order specified.*



28

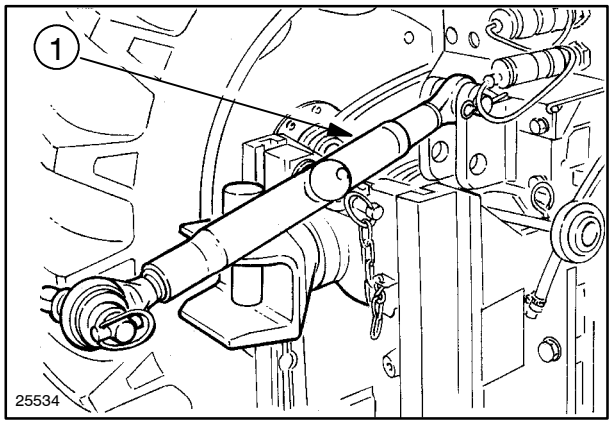
Op. 35 110 30
REAR LIFT R.I.

DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that the load is supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

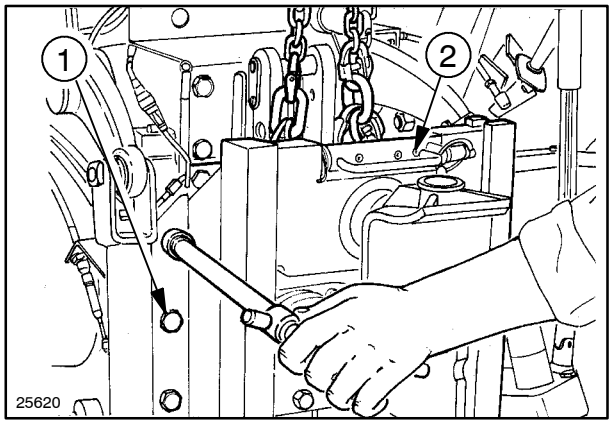
To detach the hydraulic lift from the rear transmission casing, proceed as follows.

1. Remove the top link (1) of the three-point linkage.



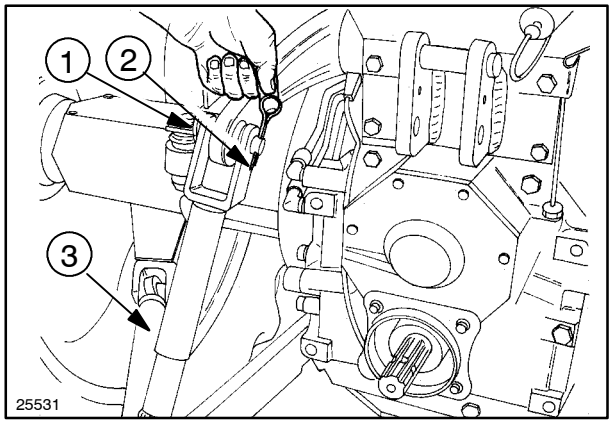
29

2. Take out the bolts (1) and, using a chain and hoist, remove the hitch hook unit (2) from the PTO housing.



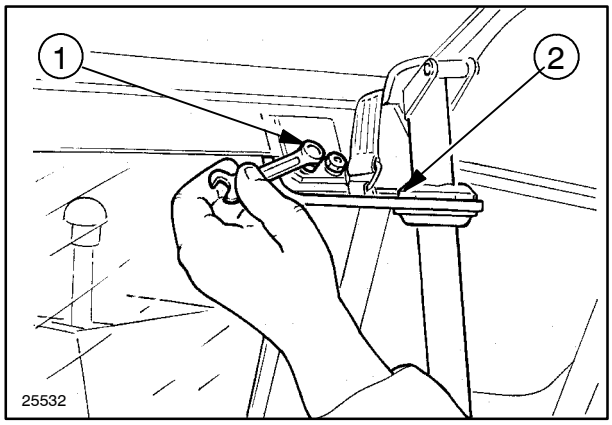
30

3. Remove the split pins and extract the pins (1), remove the vertical tie-rods (2) and anti-swing rods (3).



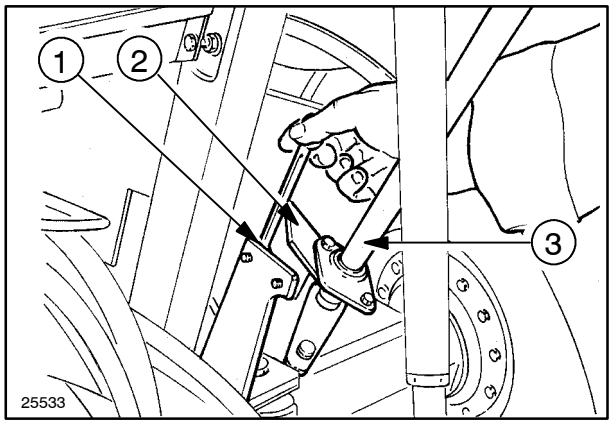
31

4. Take out the bolts (1) and remove the bracket (2) supporting the right-hand tie-rod adjustment crank.



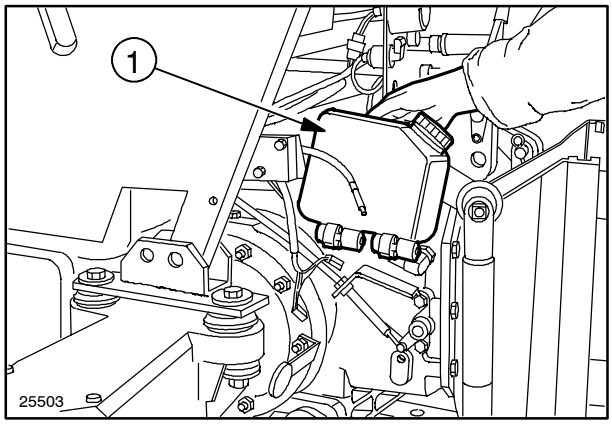
32

5. Unscrew the nuts (1) and remove the bracket (2) supporting the lever (3) governing the lift ground control.



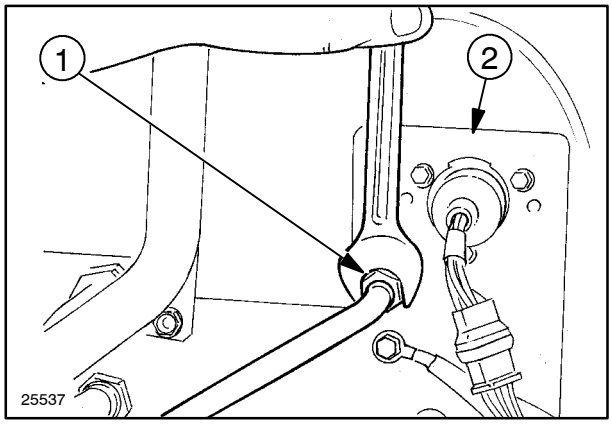
33

6. Disconnect the electrical connections and the delivery lines and remove the window washer liquid tank (1).



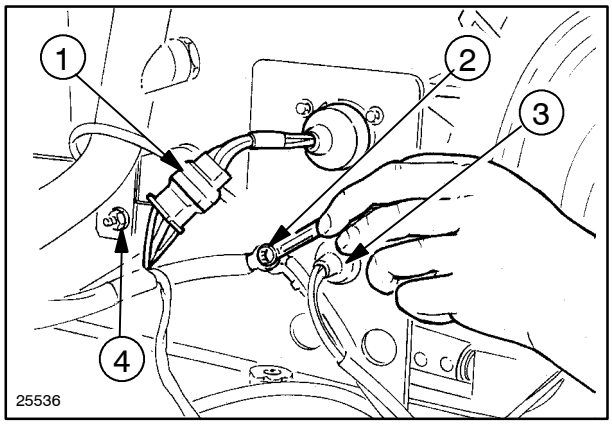
34

7. Remove the trailer brake piping (1) and the auxiliary control valves lines from the support plate (2).



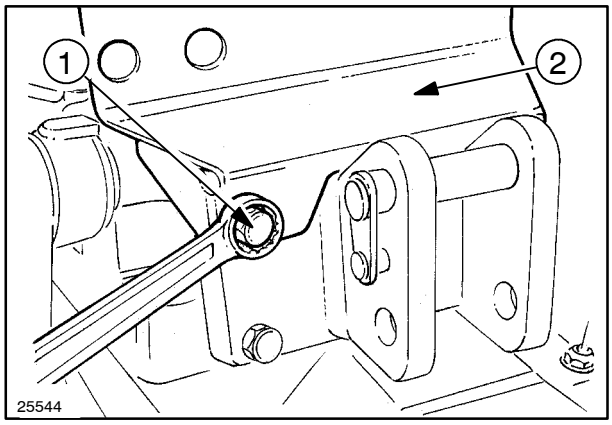
35

8. Disconnect the electrical connection (1) of the seven-pin socket (2), remove the two-pin socket (3) from its support, take out the screws (2 and 4) to free the filler pipe and disconnect the ground cables.



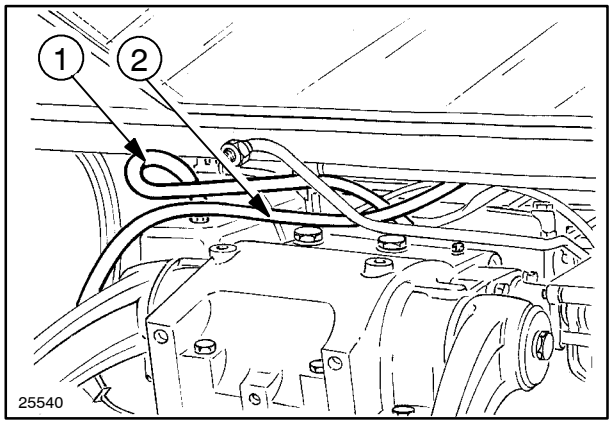
36

9. Take out the bolts (1) securing the three-point top link support and remove it together with the supporting plate (2).



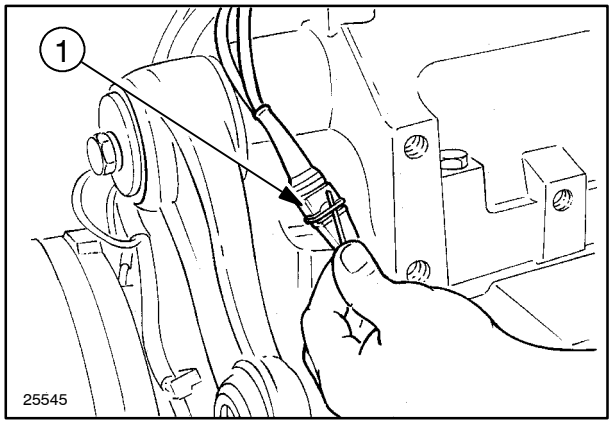
37

10. Detach the fuel (1) and transmission oil (2) breather pipes from the cab upright.



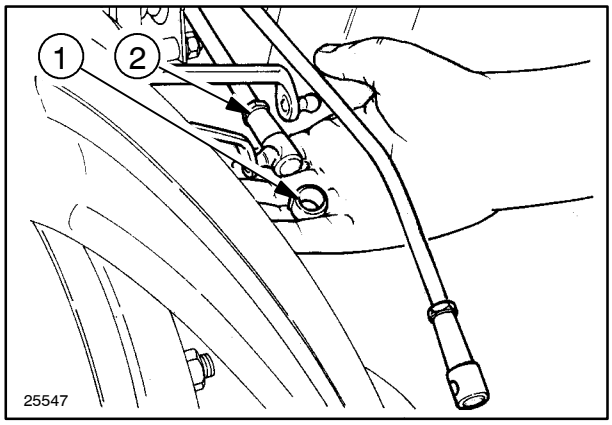
38

11. Disconnect the electrical connection (1) on the PTO rev counter.



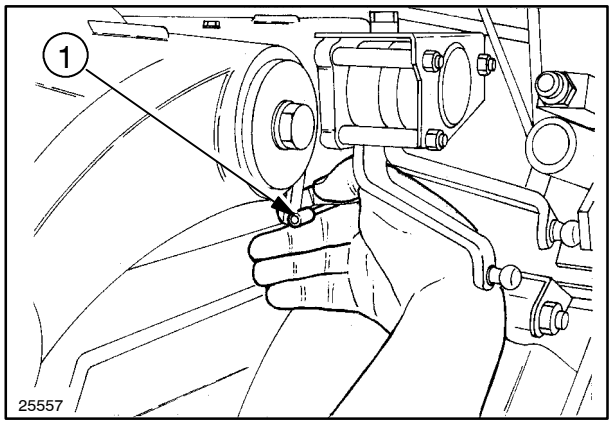
39

12. Extract the spring clips (1) and detach the two lift levers tie-rods (2).



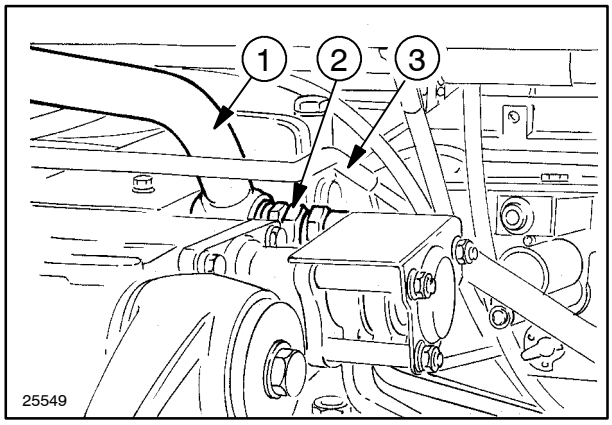
40

13. Detach the tie-rod (1) on the LIFT-O-MATIC.



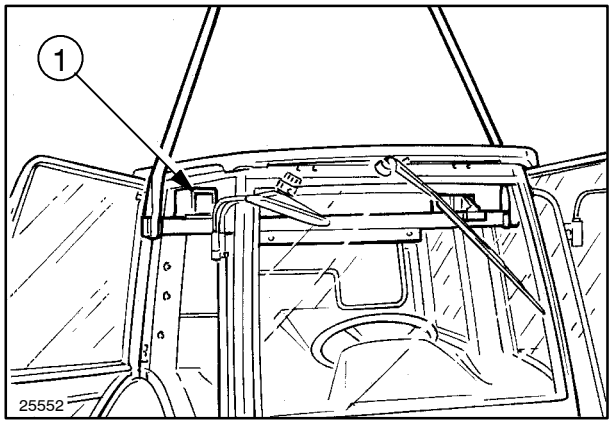
41

14. Unscrew the union (2) and disconnect the gear-box-transmission casing oil filler pipe (1), unscrew and remove the trailer brake control pipe (3).



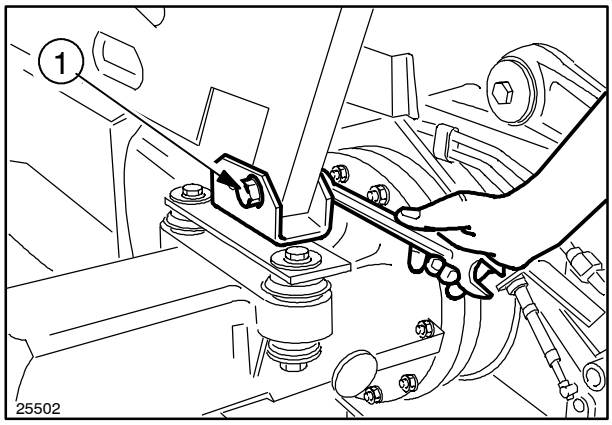
42

15. Position tool **380000294** (1) inside the cab, hitch to a hoist using 2 nylon slings and take up the slack.



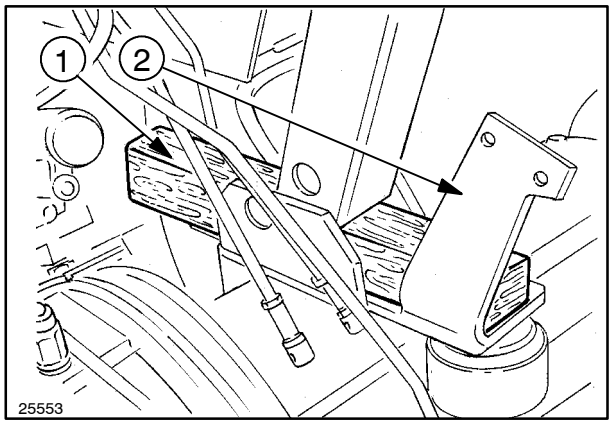
43

16. Take out the two bolts (1) securing the cab at the rear.



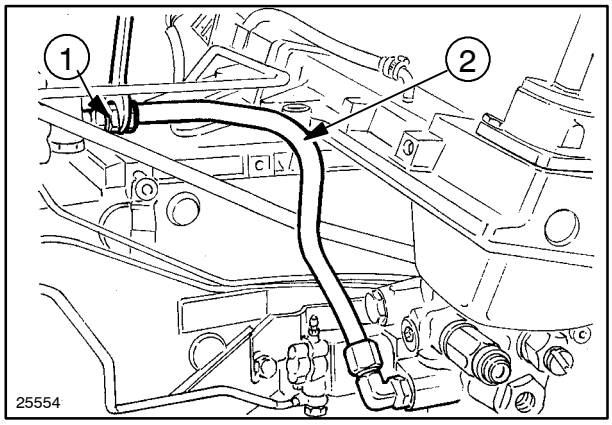
44

17. Raise the cab by approximately 1.9685 to 2.3622 in. (5 to 6 cm) and place two wooden blocks (1) between the cab upright and the relative bracket (2), lower the hoist and leave tool **380000294** inside the cab.



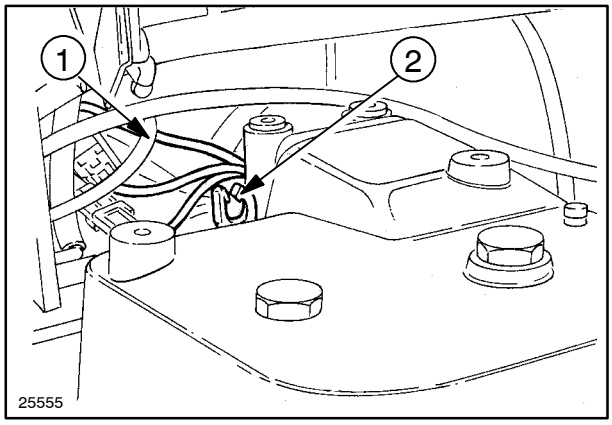
45

18. Remove the union (1) and detach the pipe (2) from the control valve.



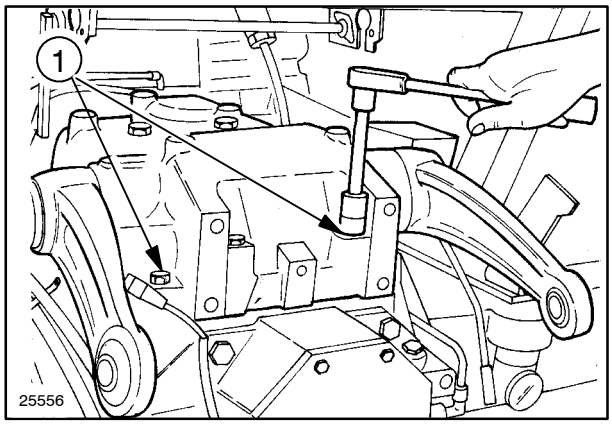
46

19. Extract the electrical cables (1) from the clip (2) on the lift.



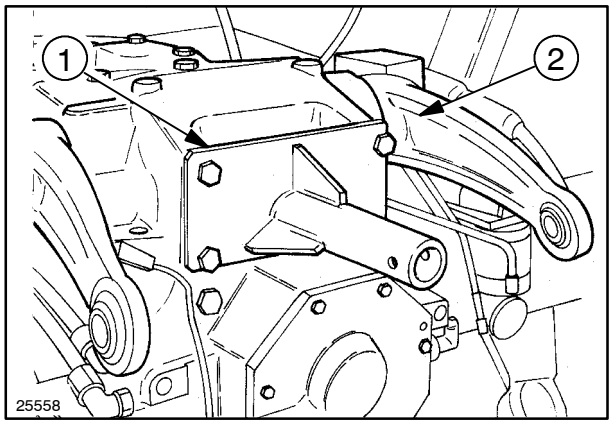
47

20. Take out the bolts (1) securing the hydraulic lift to the gearbox–transmission casing.



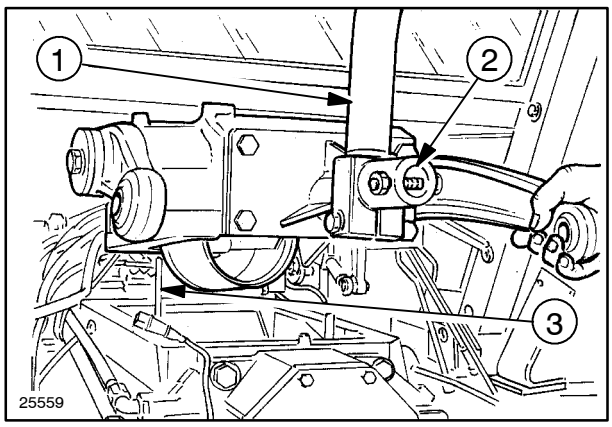
48

21. Fit tool **380000238** (1) on the lift, tightening the four bolts (2).



49

22. Fit tool **380000224** (1) on tool **380000238** (2). Attach tool **380000224** to the hoist, raise the hydraulic lift by a few centimetres and pull back in order to pass over the breather pipe (3) without causing damage.



50

23. To refit the hydraulic lift to the transmission-gearbox casing, proceed as follows.

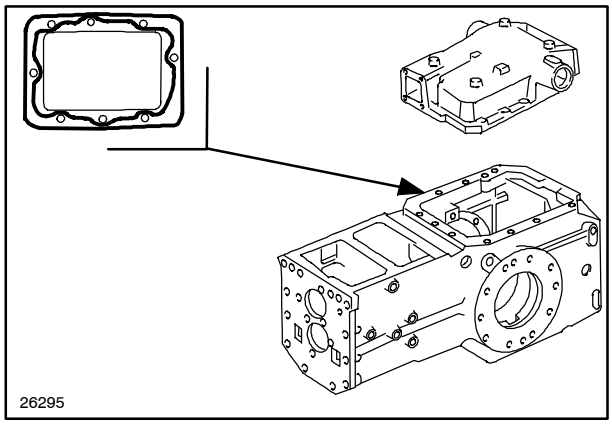
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Before reassembling the hydraulic lift on the rear transmission casing, carefully clean and degrease the mating surfaces, then apply sealing compound [approx. 0.7874 in. (2 mm)] along the marked line shown in the drawing.
- Apply the torque settings listed on pages 7 and 8.
- Using tools **380000224** and **380000238** fit the hydraulic lift on the transmission-gearbox casing and secure with the relative bolts.
- Insert the electrical cables in the clip on the lift body.
- Fit the lift control pipe.
- Raise the cab slightly, remove the wooden blocks and secure the cab with the relative bolts.
- Assemble the trailer brake pipe and the oil filler pipe.
- Connect the Lift-o-Matic control tie-rod.
- Connect the lift levers to the relative tie-rods.
- Connect the PTO revs counter electrical connection.
- Attach the fuel tank and transmission-gearbox breather pipes to the cab upright.
- Assemble the three-point top link and the quick-fit coupling support plate for the auxiliary control valves.
- Fit the two pole socket, seven pole socket, ground connections, quick-fit couplings and the trailer brake piping to the support bracket.
- Fit the window washer tank, connect the connections to the pump and the delivery lines.
- Assemble the right-hand vertical tie-rod adjustment unit.
- Fit the lift ground control lever.
- Assemble the vertical tie-rods and anti-swing rod.
- Fit the towing hook and the three-point top link.

Diagram showing application of sealing compound when fitting the hydraulic lift on the transmission-gearbox casing.

The types of sealing compounds to be applied are specified in Section 00.



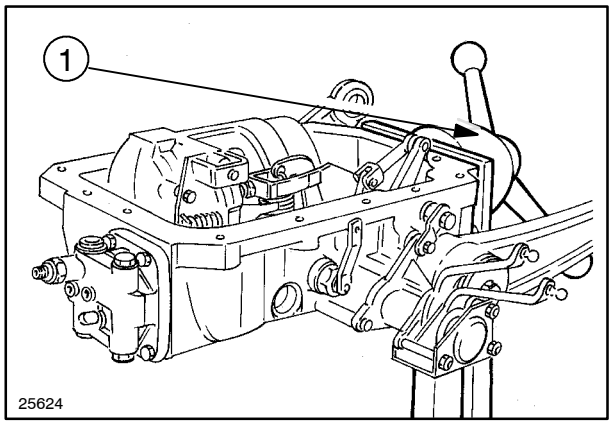
51

Op. 35 110 40 - 35 110 42 - 35 110 46
REAR HYDRAULIC LIFT D.A. Adjustments

DANGER

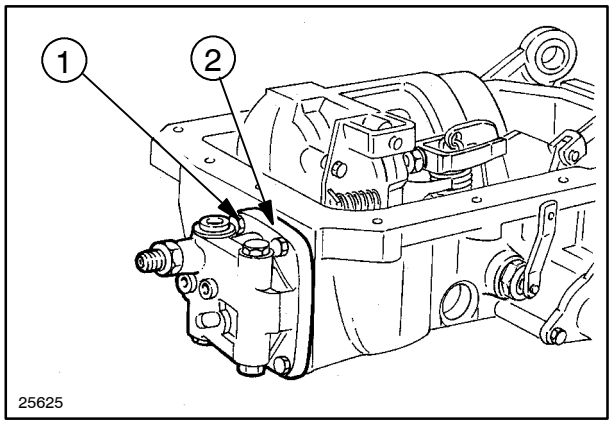
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Disassemble the external controls of the hydraulic lift as follows:



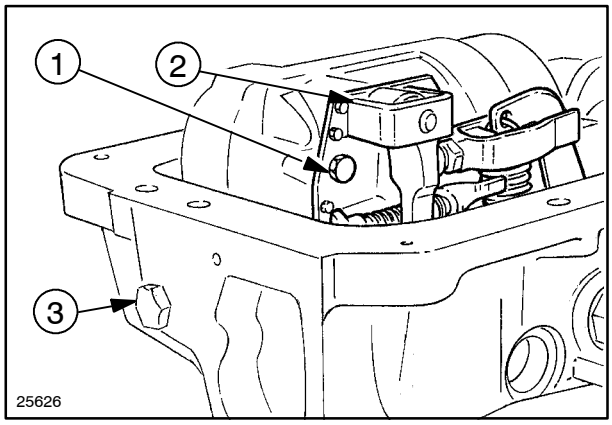
52

1. Position the hydraulic lift on a rotating stand (1, fig. 52).
2. Unscrew the retaining bolts (1) and remove the control valve (2).



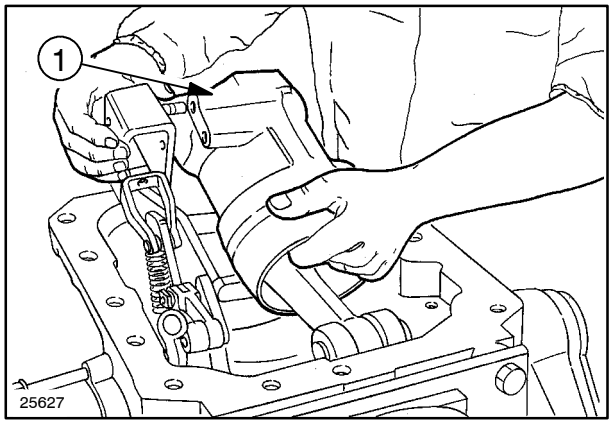
53

3. Take out the two cylinder retaining bolts located outside the lift body, turn the lift and remove the side bolt (3).
4. Unscrew the bolts (1) securing the internal levers (2) to the lift cylinder.



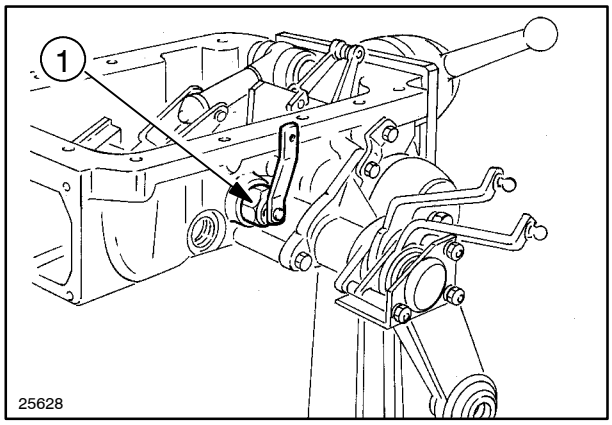
54

5. Remove the cylinder (1) and piston.



55

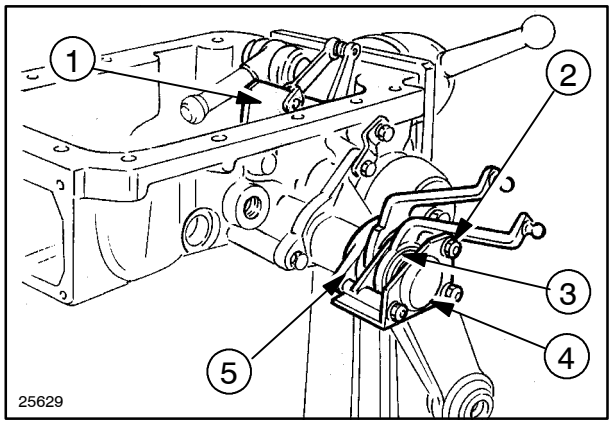
6. Extract the pin from the draft internal lever, unscrew the nut (1), recover the internal lever assembly and the LIFT-O-MATIC lever.



56

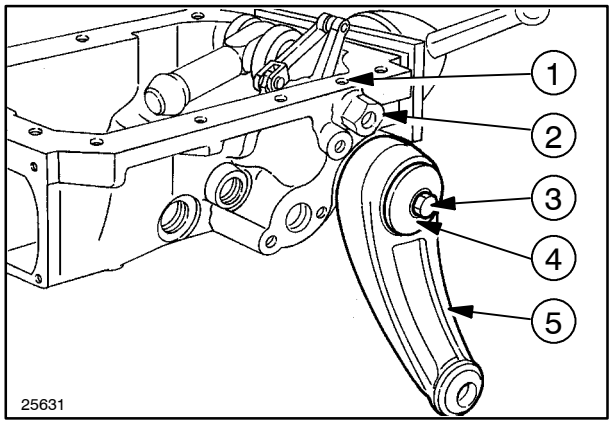
7. Remove the circlip and the position control internal lever (1).

8. Carry out the disassembly sequences 2 to 4 described in operation **35 110 17** relating to **REAR LIFT EXTERNAL CONTROLS.**



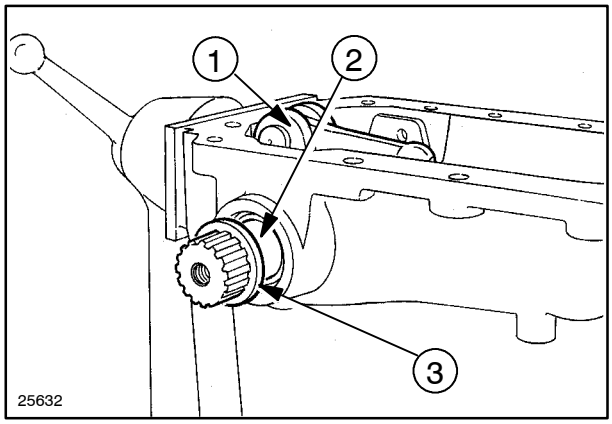
57

9. Loosen the grub-screw (1) on the eccentric pin (2), extract and recover the internal levers.
10. Unscrew the screw (3), remove the washer (4), extract the lift arm (5) and remove the thrust washer (on both arms.



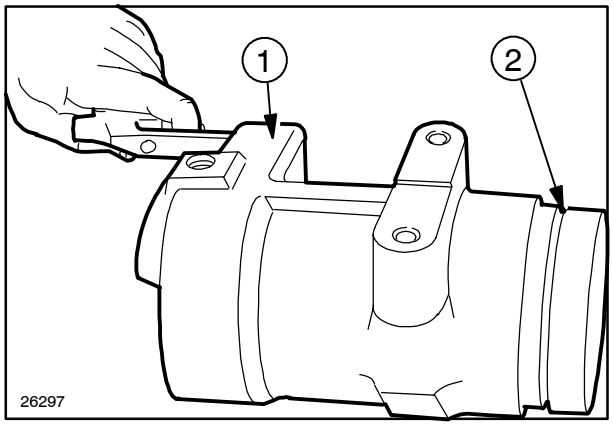
58

11. Remove the safety tab on the internal arm setscrew (1) and unscrew. Extract the shaft (2) and remove the seals (3).



59

12. Use compressed air to remove the piston (2) from its cylinder (1).

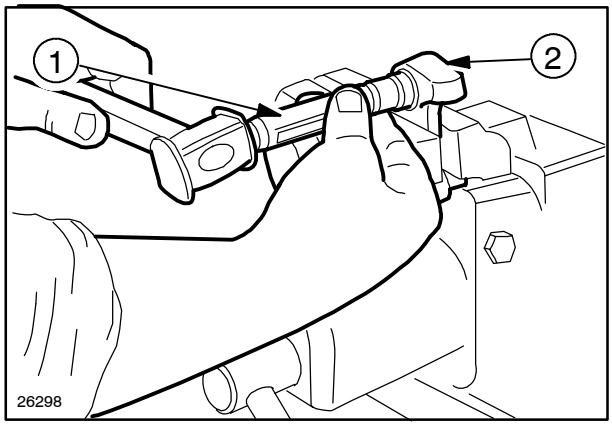


60

13. Use the striker **380000260** (1) to replace the bearings in the internal draft control lever (2).
14. Using the striker **380000261**, replace the control valve lever bearings.
15. To assemble the hydraulic lift, proceed as follows.

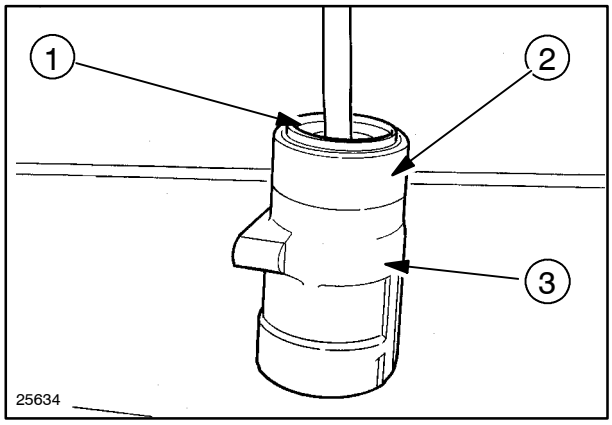
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



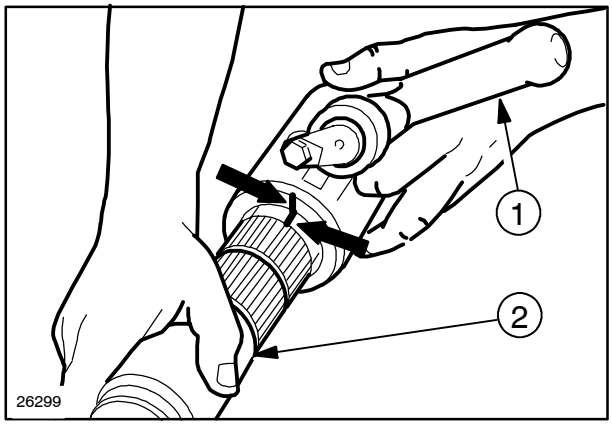
61

16. Using tool **380000225** (2), insert the piston (1) into its cylinder (3).



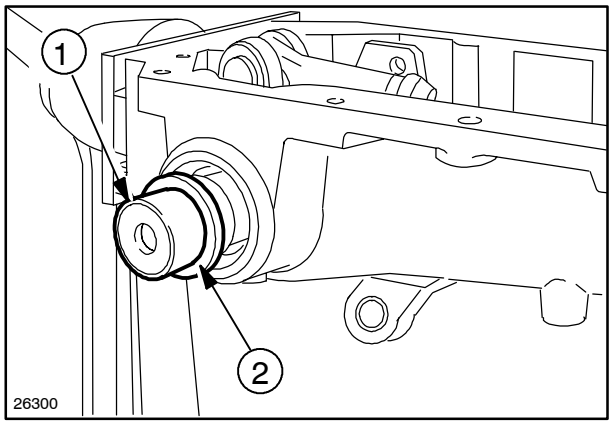
62

17. Assemble the lift arms shaft (2) and the internal arm (1) inside the lift casing, matching up the reference marks and tighten the retaining bolt.



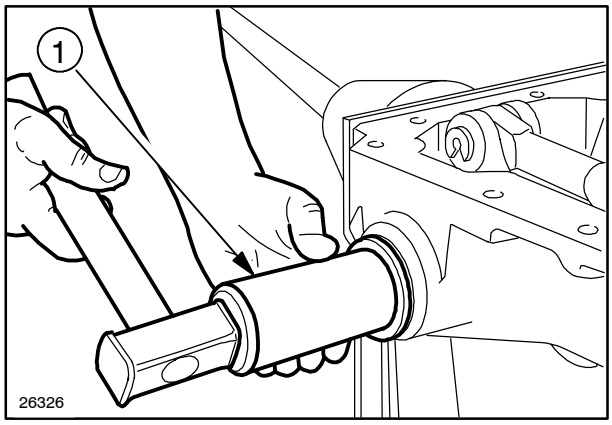
63

18. To avoid damaging the internal seal lips, use a flexible brass sheet (1) dimensions: 7.8740 x 3.5433 in. (200 x 90 mm) and thickness 0.0019 to 0.0039 in. (0.05 to 0.1 mm). Roll up the sheet and insert the seal inside.
    Position the unit on the spline and push the seal manually into its seat, then remove the brass sheet.



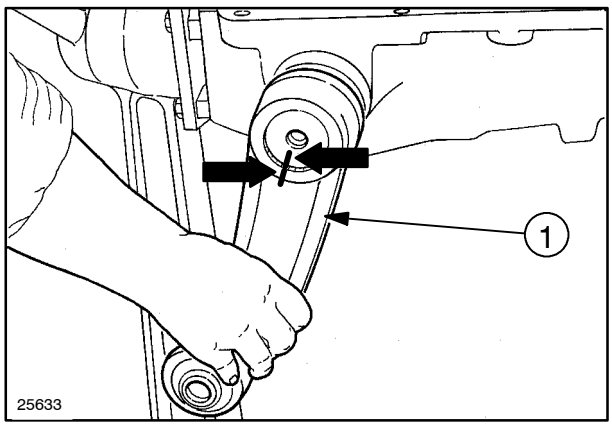
64

19. Using the striker **380000262** (1), complete the fitting of the seals into the relative seats on the arm shaft.



65

20. Fit the lift arms (1) on the shaft, matching up the reference marks. Secure in position with the bolts.



66

21. Assemble the internal levers and the eccentric pin, and secure with the grub–screw.

22. Carry out the assembly sequences described in operation **35 110 17** relating to **REAR LIFT EXTERNAL CONTROLS.**

23. Fit the internal position control lever.

24. Assemble the internal levers and the Lift–O–Matic lever.

25. Assemble and secure the cylinder and piston.

26. Assemble the internal levers and secure to the cylinder.

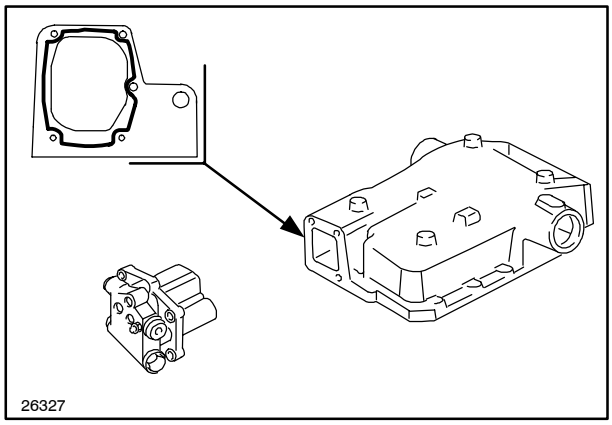
27. Carefully clean and degrease the mating surfaces, then apply sealing compound [approx. 0.7874 in. (2 mm)] along the marked line shown in the drawing.

    The types of sealing compounds to be applied are specified in Section 00.

    Fit the hydraulic lift on the lift box and secure in position with the relative retaining bolts.

    Carry out the adjustments described below.

NOTE: *The adjustments must be carried out in the order specified.*



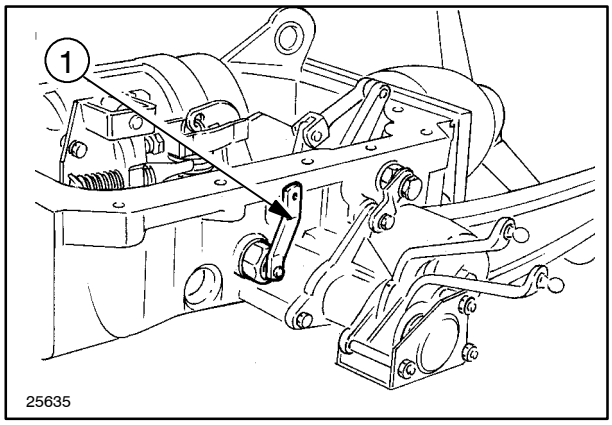
67

LIFT ADJUSTMENTS

The following adjustments refer to a lift assembly without hydraulic control valve block and mounted on a rotary stand.

These adjustments must be carried out in the order specified.

The LIFT-O-MATIC device must be kept in the OFF position (external lever (1) locked in the vertical position) unless otherwise indicated.

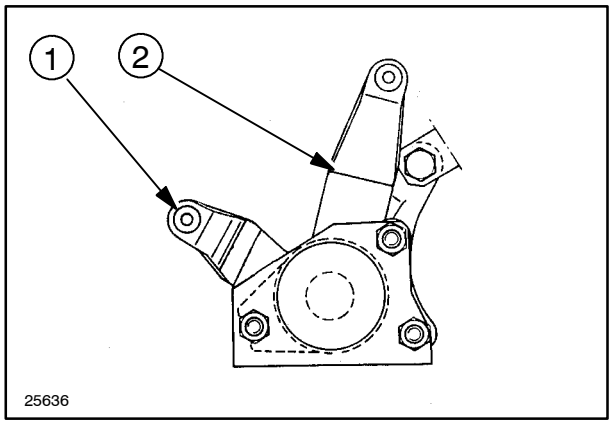


68

Adjusting controlled position

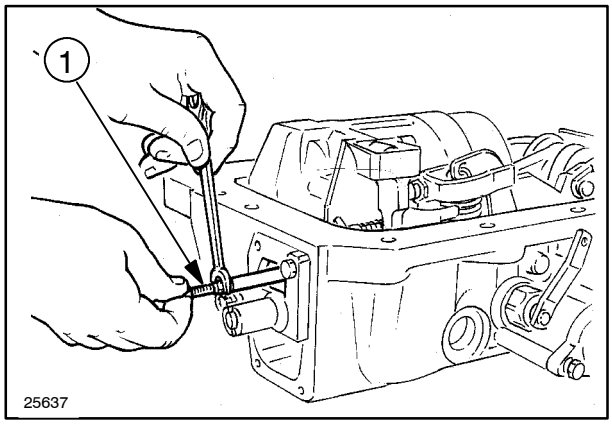
Proceed as follows.

28. Move the external position control lever (1) completely forward against the spacer for the stud bolt securing the spring retaining bracket, and the external draft control lever (2) completely back against the spacer.
29. Turn the arm control shaft so that the internal arm comes into contact with the lift body.

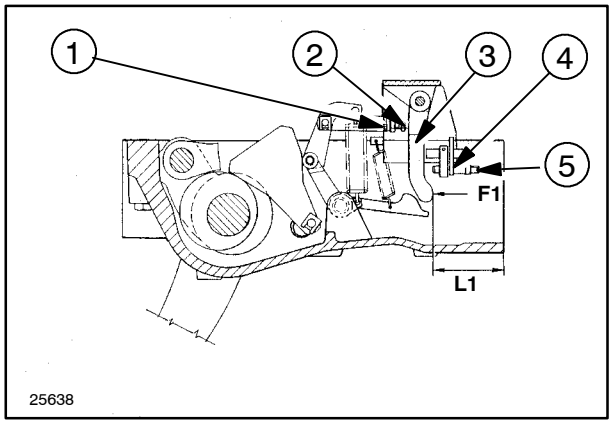


69

30. Using wrench **380000267** (1) loosen the locknut (4, figure 71) and totally unscrew the adjustment screw (5) until it no longer makes contact with the control valve lever (3).



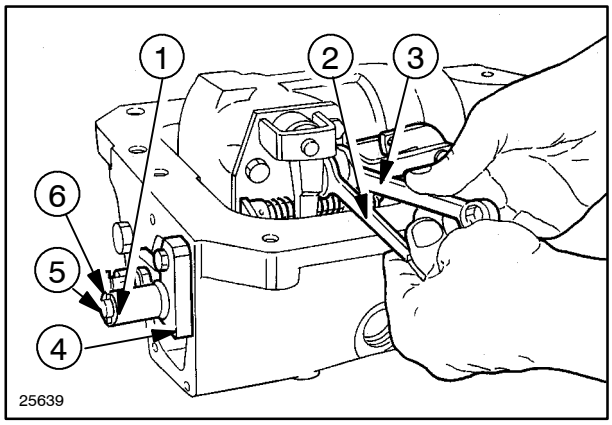
70



71

31. Assemble tool **380000264** (4) on the lift body.
32. Using wrenches (2 and 3) unscrew the locknut (1, fig. 71) and tighten or loosen the adjustable push rod (2, fig. 71), so that the end of the mobile cap (5) is on exactly the same external contact plane (6) as the tool (4), as shown in the figure.

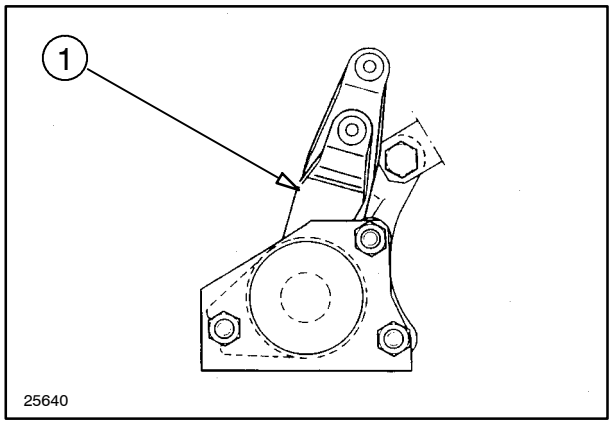
NOTE: *This corresponds to a distance (L1, fig. 71) of 3.2283 to 3.2322 in. (82.0 to 82.1 mm) between the end of the lever (3, fig. 71) and the front plane of the lift body, measured applying a force (F1, fig. 71) of 4 to 4.5 da N (kg) on the end of the lever.*



72

33. Tighten the locknut (1, fig. 71).
34. Move the external position control lever (1) completely back against the stud bolt spacer, rotate the arms shaft so that the piston is fully forward and check that the mobile cap (5, fig. 72) is on the same plane or re-enters in relation to the internal contact surface (1, fig. 72) of the tool (4, fig. 72).

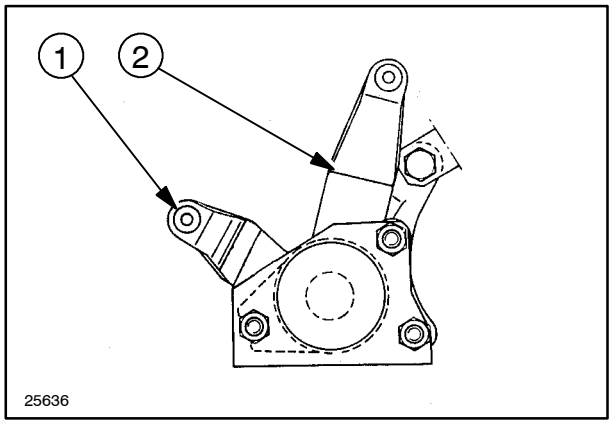
NOTE: *This corresponds to a distance (L1, fig. 71) greater than 3.4055 in. (86.5 mm) between the end of the lever (3, fig. 71) and the front plane of the lift body measured applying a force (F1, fig. 71) of 4 P 4.5 da N (kg) on the end of the lever.*



73

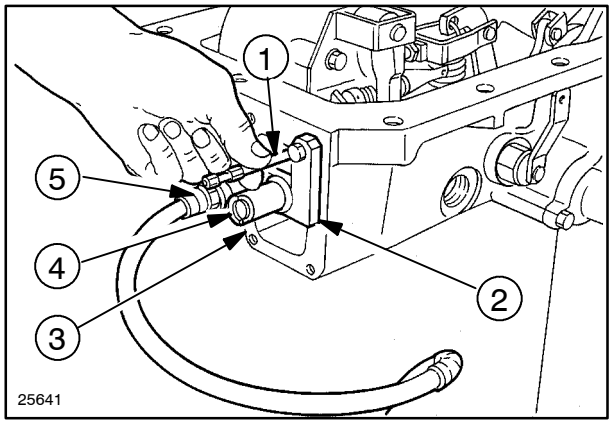
Lift arms maximum raise position adjustment.
Proceed as follows.

35. With tool **380000264** (2, fig. 72) fitted on the lift body, position the external draft lever (2) fully back against the spacer, and the position control external lever (1) fully forward, against the spacer.
36. Turn the arm control shaft so that the internal arm comes into contact with the lift body.



74

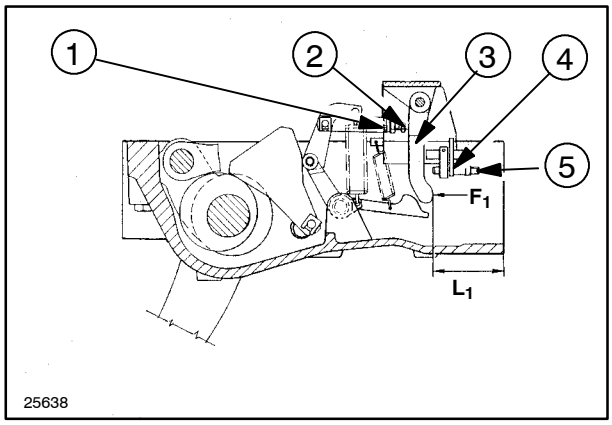
37. Connect the union (5) on the tool (2) to the workshop compressed air supply and inject air into the cylinder sleeve, so that the piston carries out the lifting stroke, and maintain in this position by means of the air pressure.
38. Using wrench **380000267** (1) tighten the screw (5, fig. 71), until the end of the mobile cap (4) is on the same level as the internal contact surface (3) of the tool (2) or it re-enters up to a distance of 0.0196 in. (0.5 mm) in relation to the contact surface.



75

NOTE: *This corresponds to a distance (L1) of 3.3976 to 3.4133 in. (86.3 to 86.7 mm) between the end of the lever (3) and the front plane of the lift body.*

39. Tighten the bushing locknut (4) to a torque setting of 15 Nm (1.5 kgm).



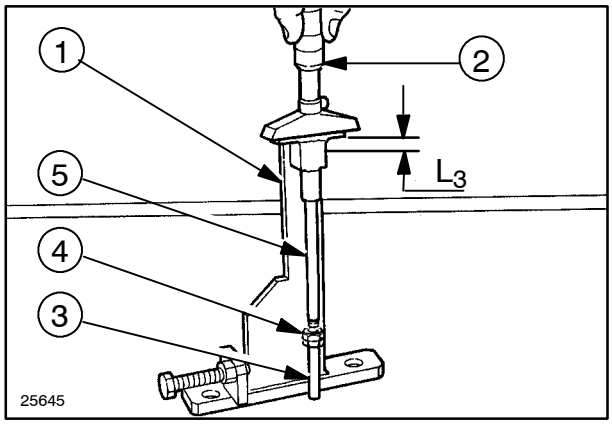
76

Controlled draft adjustment

Proceed as follows:

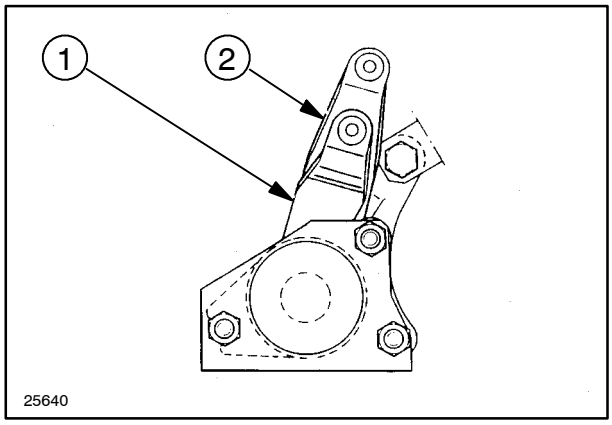
40. Disassemble the end part of the draft control rod (3) and fit on the rod (5) of tool **380000263** (1), securing in position with the relevant locknut (4).

41. Position tool **380000263** (1) complete with rod (5) and the end part of the draft control rod (3) on a reference plane and, using a depth gauge (2), read the value (L_3) between the upper surface of the rod and the gauge resting on the tool (always tighten rod (3) on rod (5) so that the surface of rod (5) is slightly lower than the gauge on the tool).



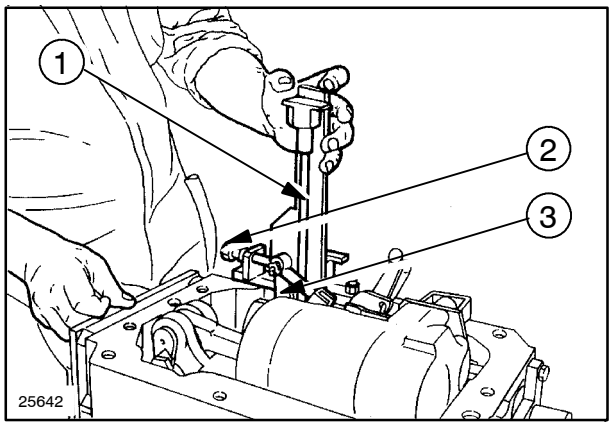
77

42. With tool **380000264** (4, fig. 72) fitted on the lift body and disconnected from the compressed air system, move the position control lever (1) and draft control lever (2) fully forward, against the spacer.



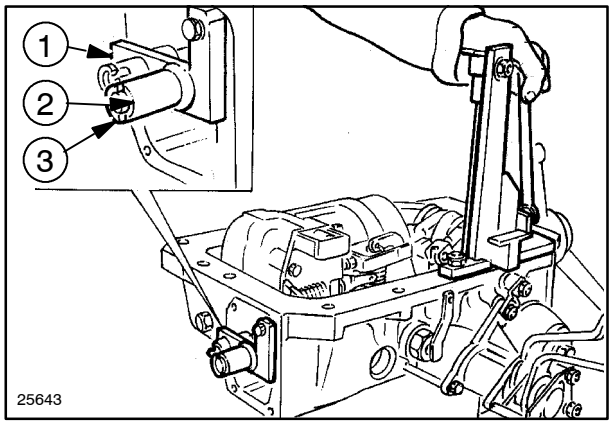
78

43. Position the draft control internal lever eccentric pin (1, fig. 83) in the horizontal position with the cam facing towards the rear part of the lift.
44. Assemble tool **380000263** (1) on the lift body, attaching it to two holes on the casing, as indicated in the figure.



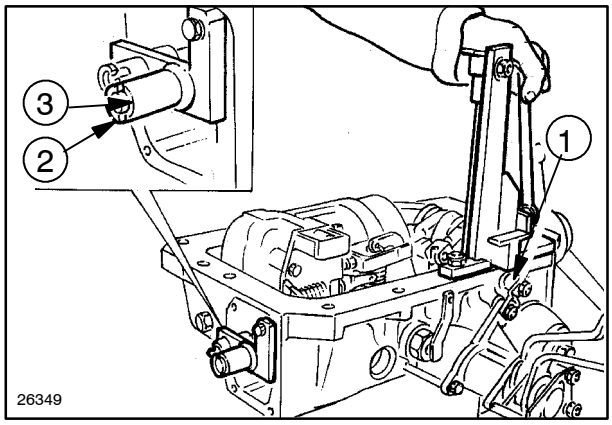
79

45. Adjust the screw (2, fig. 79) on the draft control internal lever (3, fig. 79) until the end of the mobile cap (1) is as near possible to the internal surface (2) of tool **380000264** (3).



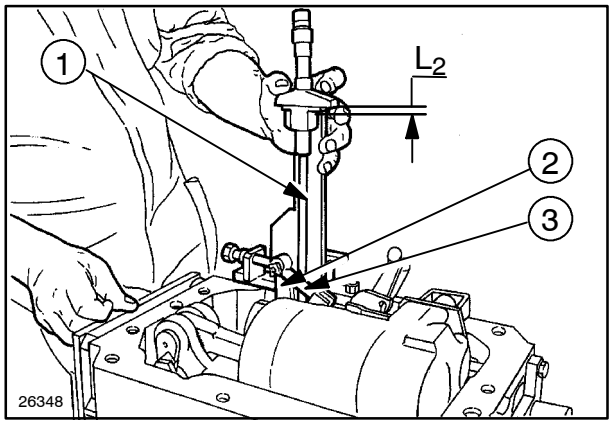
80

46. Slightly rotate the eccentric pin (1) to fully insert the mobile cap on tool **380000264**.
47. Adjust the screw (2, fig. 79) on the draft control internal lever (3, fig. 79) until the end of the mobile cap is on the same plane as the internal surface (3) of tool **380000264**.
48. Rotate the eccentric pin (1) until the end of the mobile cap is on the same plane as the external surface (2).



81

49. Insert the rod of tool **380000263** (1) in the seat of the draft control internal lever (2).
50. With the end of the mobile cap on tool **380000264** on the same plane as the external surface (2, fig. 81), adjust the tie-rod (3) and, using a depth gauge, read the value (L_2) between the upper surface of the rod and the contact surface of the gauge on the tool **380000263** (1).



82

51. The distance (L_2, fig. 82) must be:

$$L_2 = L_3 + L_4$$

where:

L_3 = value measured with tool **380000263** fitted on contact surface;

L_4 = 0.9015 to 0.9094 in. (22.9 to 23.1 mm). Operating value between lift body surface on transmission casing and rod contact surface on lever (3, fig. 82).

NOTE: *This corresponds to a distance (L1, fig. 71) of 3.2283 to 3.2322 in. (82.0 to 82.1 mm) between the end of the lever and the front plane of the lift body, measured applying a force (F1) of 4 to 4.5 da N (kg) on the end of the lever.*

CAUTION

Always check that when the mobile cap is positioned exactly on the same plane as the external surface (2) of tool **380000264** the distance (L_2, fig. 82) is:

$$L_2 = L_3 + L_4$$

where:

L_3 = value measured with tool **380000263** fitted on contact surface;

L_4 = 0.9015 to 0.9094 in. (22.9 to 23.1 mm). Operating value between lift body surface on transmission casing and rod contact surface on lever (3, fig. 82).

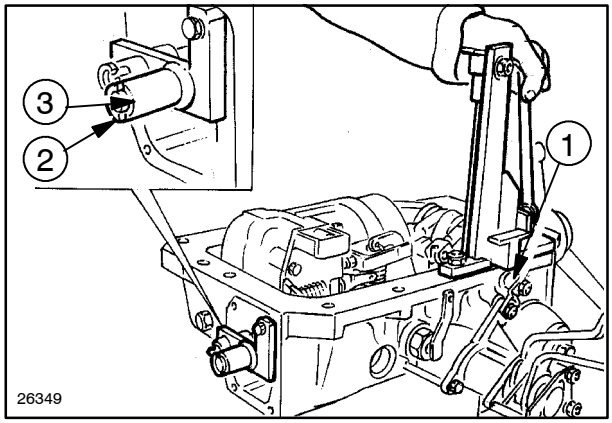
If not, adjust the eccentric pin (1) and the knurled screw (2, fig. 82) on tool **380000263** until the aforementioned values are obtained.

52. Fit the threaded grub screw (3) and tighten the screw (1) without beading the safety washer (2).
53. Disassemble tools **380000264** and **380000263** and assemble the hydraulic control valve on the lift body.

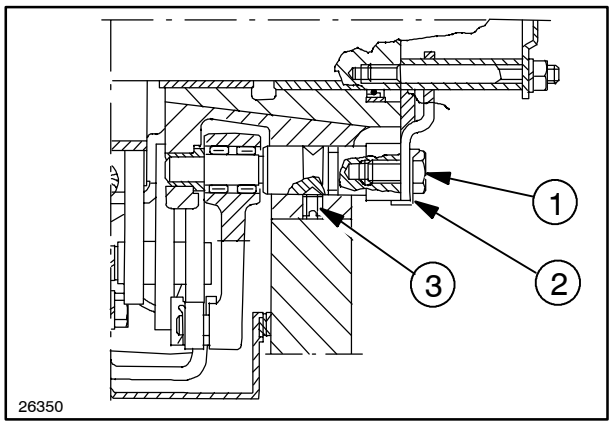
Fit the lift on the tractor as follows.

WARNING

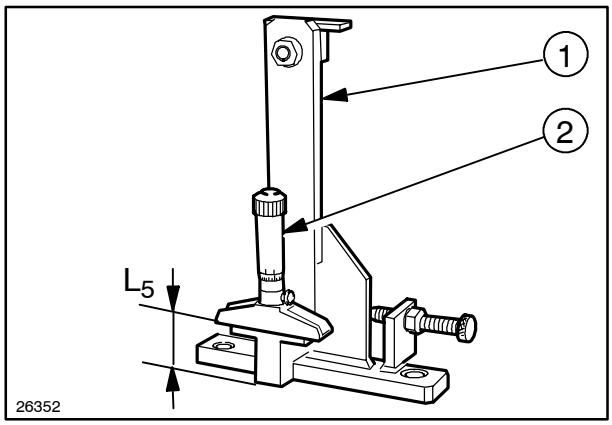
First position tool **380000263** (1) on a reference surface and use a micrometer depth gauge (2) to measure the distance (L_5) between the point where the tool rests on the reference surface and the point where the micrometer gauge rests on the tool.
Mark the measured distance (L_5) on the tool.



83



84



85

54. Fit the draft measuring device, complete with drive lever (3) and draft control rod (2) but without the flex bar, on the rear transmission housing.
55. Rest the drive lever (3) on the draft measuring device casing and assemble tool **380000263**, securing in the two holes on the casing so that the draft control rod (2) is precisely inserted in the hole on the tool, as indicated in figure 87.
56. Using a depth gauge (2, fig. 87), measure the distance (L_8, fig. 87) between the top end of the rod (3, fig. 87) and the contact surface of the gauge on the tool.

NOTE: *The protrusion (L_6) of the upper end of the rod (2) beyond the transmission casing (with flex bar disassembled) will be given by:*

$$L_6 = L_5 - L_8$$

where:

L_5 *and* ***L_8*** *= distances measured with tool* ***380000263*** *fitted on the reference surface (L_5, fig. 85) or on the transmission housing (L_8, fig. 87)*

---

57. Assemble the flex bar and measure the new value (L_9) between the upper end of the rod (3) and the depth gauge contact surface on the tool.

NOTE: *The protrusion (L_7, fig. 86) of the top end of the rod (2, fig. 86) beyond the transmission casing (with flex bar fitted) will be given by:*

$$L_7 = L_5 - L_9$$

where:

L_5 *and* ***L_9*** *= distances measured with tool* ***380000263*** *fitted on the reference surface (L_5, fig. 85) or on the transmission housing (L_9).*

---

58. Check that the distance (L_7) is at least 0.1968 in. (5 mm) greater than the distance (L_6).
59. Loosen the locknut (1, fig. 86) and adjust the length of the draft control rod until a new protrusion of (L_7 = 0.7204 to 0.7283 in. (18.3 to 18.5 mm) is obtained.
60. This protrusion (L_7) can be calculated by subtraction using tool **380000263** :

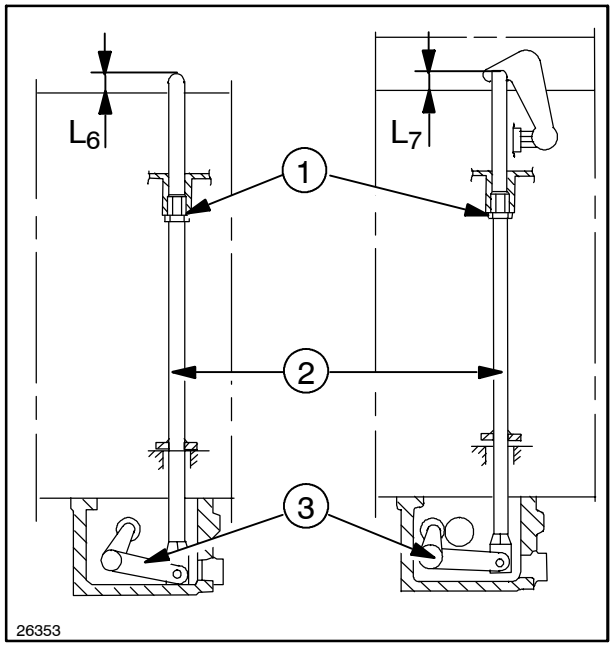
    $L_{10} = L_5 - L_7$

    where:

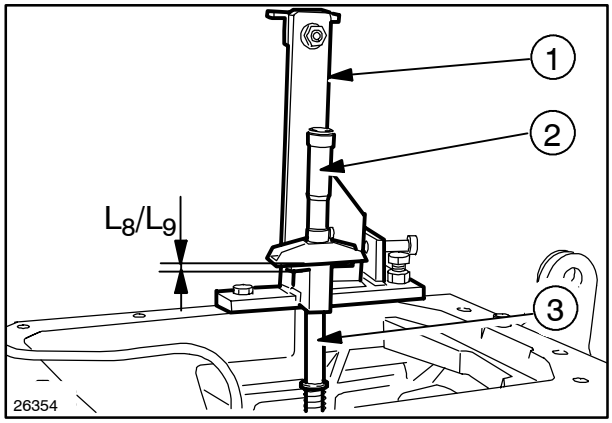
    L_7 = 0.7204 to 0.7283 in. (18.3 to 18.5 mm). The distance the end of the rod (2, fig. 86) protrudes in relation to the transmission casing.

    L_5 = value measured with tool **380000263** fitted on contact surface.

    L_{10} = distance to be measured with the micrometer gauge on the tool **380000263**.
61. Tighten the locknut (1, fig. 86) and assemble the lift on the tractor.



86



87

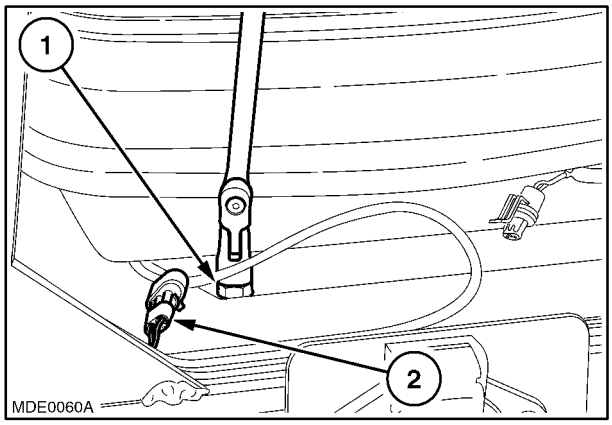
Op. 35 114 10
LIFT CONTROL VALVE R.I.

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

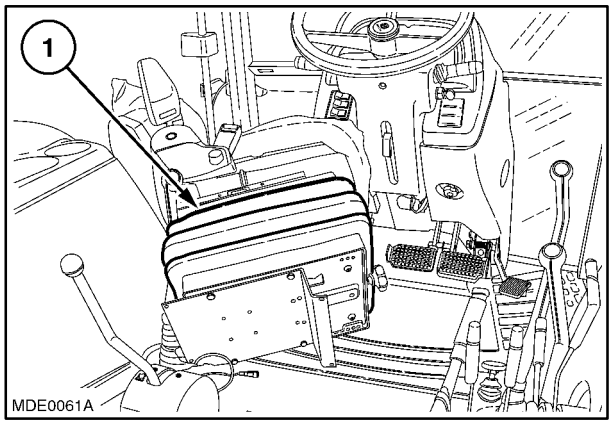
Proceed as follows.

1. Disconnect the driving seat occupied/safety and pneumatic seat height adjustment electric cable (2).
2. Take out the four bolts (1) securing the seat to the platform.



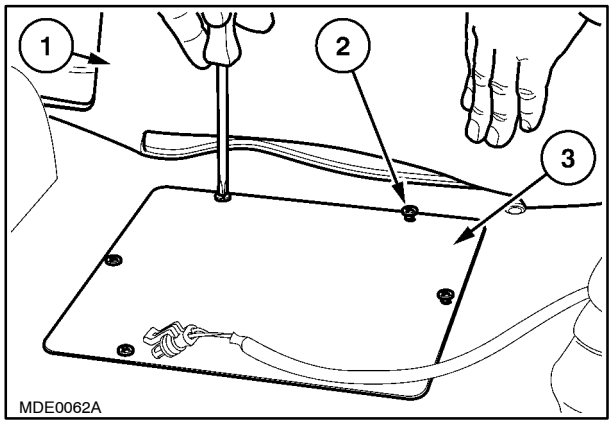
88

3. Move the seat (1) to the front part of the platform so that it does not obstruct the following disassembly operations.



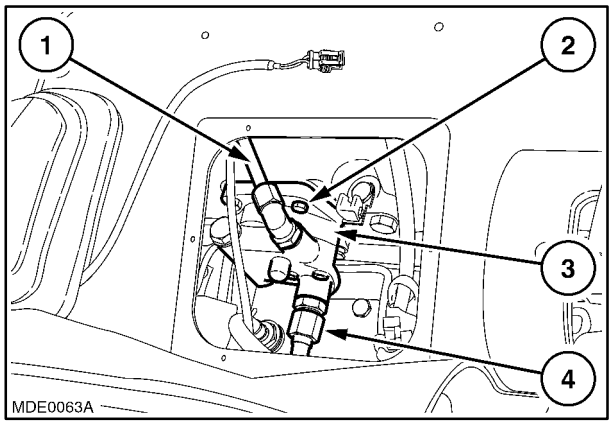
89

4. Lift the mat (1) located on the rear part of the platform.
5. Remove the retaining bolts (2) and the cover (3) installed on the platform.



90

6. Disassemble lines (1) and (4) connected to the control valve, unscrew the securing bolts (2) and the control valve (3).



91

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

7. To refit the control valve to the hydraulic lift body, proceed as follows:

- For the correct orientation of the various parts, refer to the previous illustrations.
- Before reassembling the control valve on the lift body, carefully clean and degrease the mating surfaces, then apply sealing compound [approx. 0.7874 in. (2 mm)] along the marked line shown in the drawing 67.
- Refit the control valve on the hydraulic lift body, tighten the bolts to the torque values listed on page 7.
- Reconnect the hydraulic lines to the control valve.
- Reassemble the cover on the platform and tighten the retaining bolts.
- Reposition the mat on the rear part of the platform.
- Refit the seat and tighten the retaining bolts.
- Reconnect the safety cable.

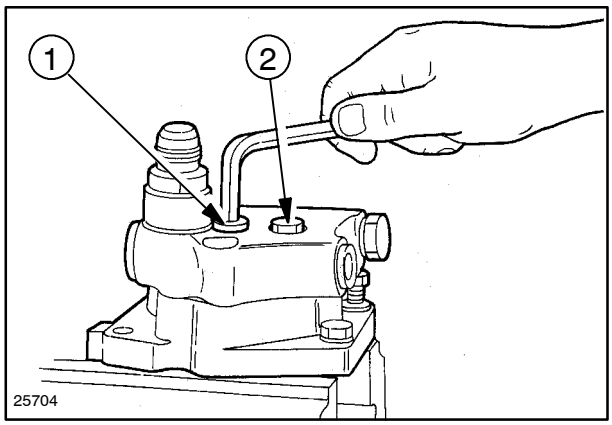
Op. 35 114 14
LIFT CONTROL VALVE D.A.
with control valve removed

Proceed as follows.

CAUTION

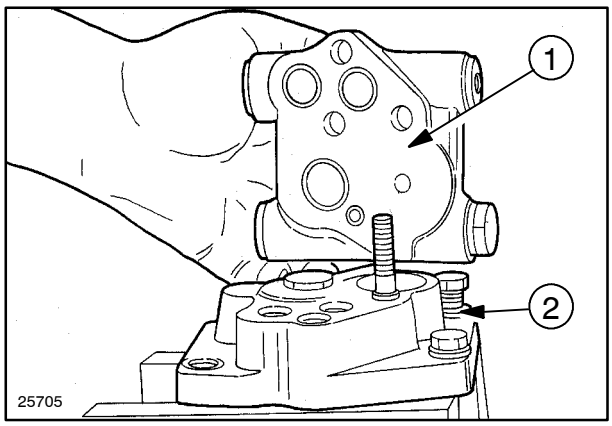
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Before disassembly, thoroughly clean the surfaces of the control valve, clamp the control valve in a vice and unscrew bolts (1) and (2).



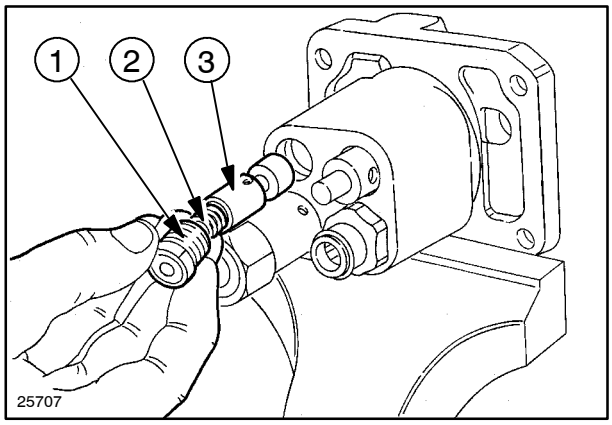
92

2. Remove the cover (1) from the control valve body (2).



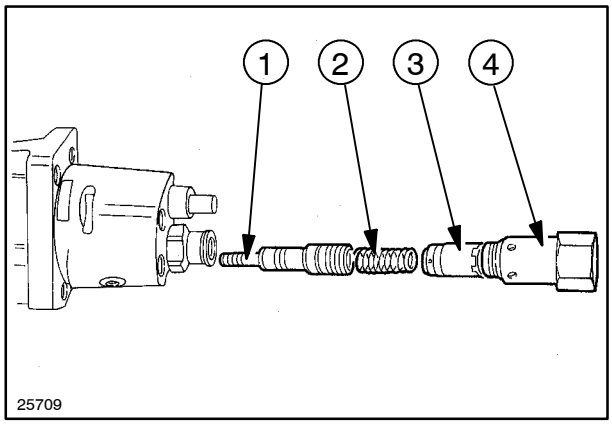
93

3. Unscrew the cap (1) and remove the spring (2) and the control valve (3).



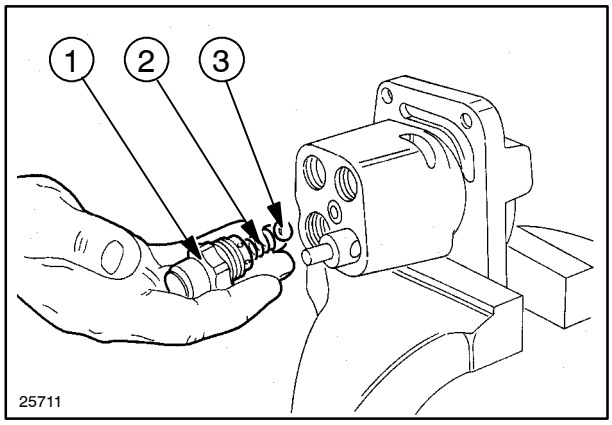
94

4. Remove the cylinder safety valve (4) and recover the arm lowering speed adjustment valve (3), the spring (2) and the pin (1).



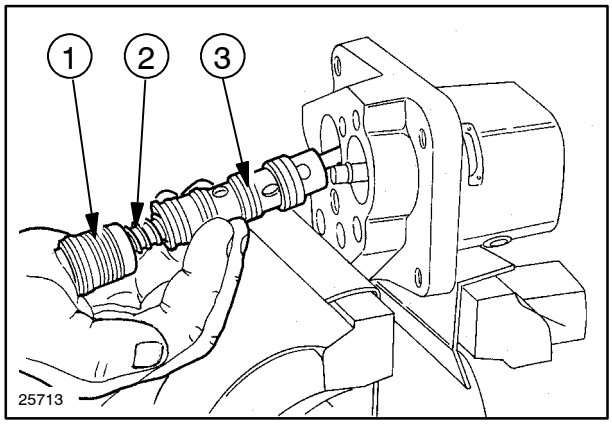
95

5. Remove the check valve: union (1), spring (2) and ball (3).



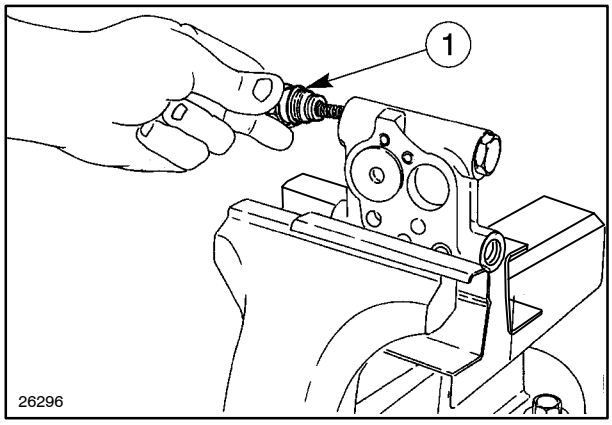
96

6. Extract the control valve pin (1) its seat (3) and the spring (2).



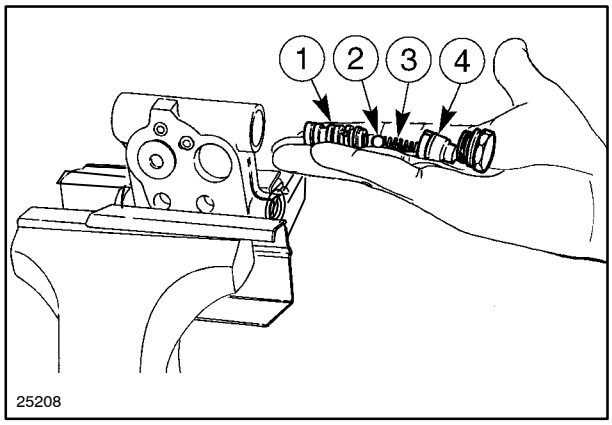
97

7. Remove the cap (1) and spring and the delivery control valve shutter.



98

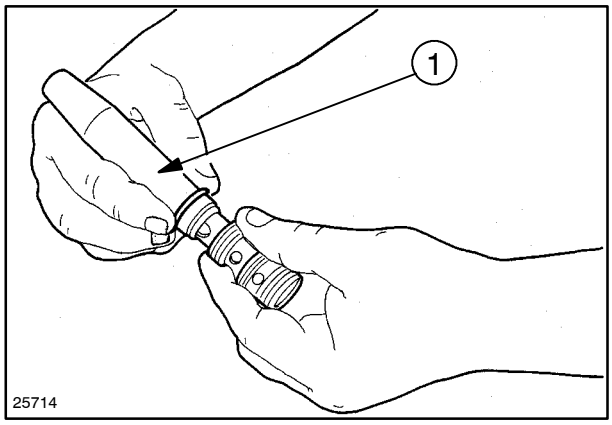
8. Remove the piston (1), spring (3), ball (2) and shutter (4) of the delivery control valve.



99

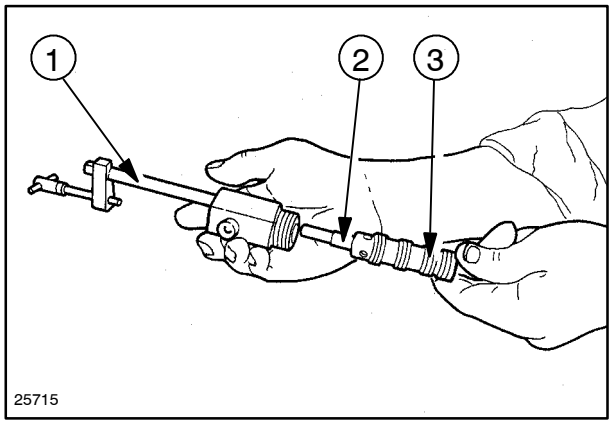
9. Check the wear of the seals on the control valve block-pin seat. If damaged, replace the seals using protection device **380000275** (1) and following the instructions on page 11.

10. Check the efficiency of the control valve block pin as follows.



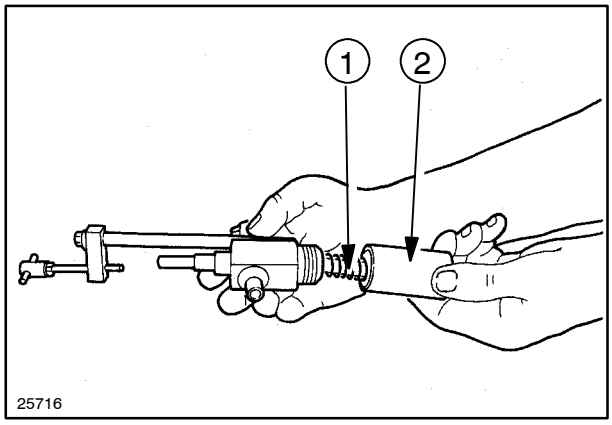
100

11. Fit the control valve block pin (2) complete with seat (3) on the tool **380000274** (1).



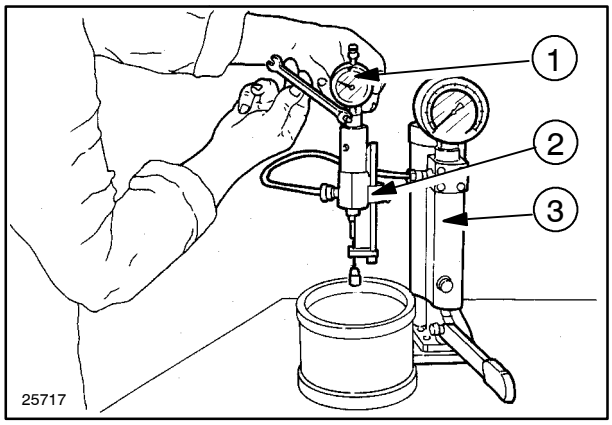
101

12. Fit the control valve block pin spring (1) and the cap (2) of tool **380000274**. Tighten the cap as far as it will go and check that the control valve block-pin slides in its seat.



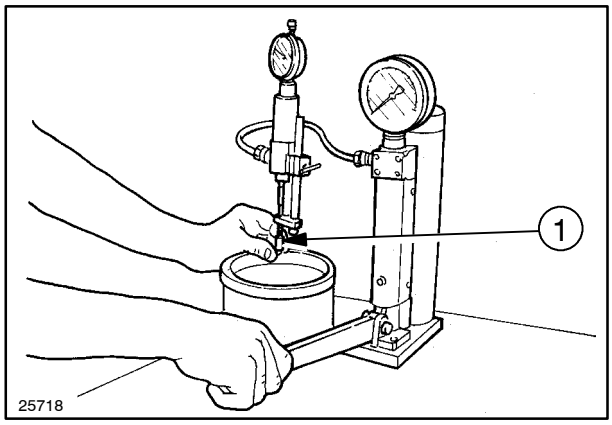
102

13. Fit tool **380000274** (2) on the hand pump **380000275** (3), supplied with **ISO VG 68**, **DIN 51524** / **51525** oil (for outside temperatures of 0 to 122 °F (0 to 50 °C). Connect a dial gauge (1), securing in position with the screw.



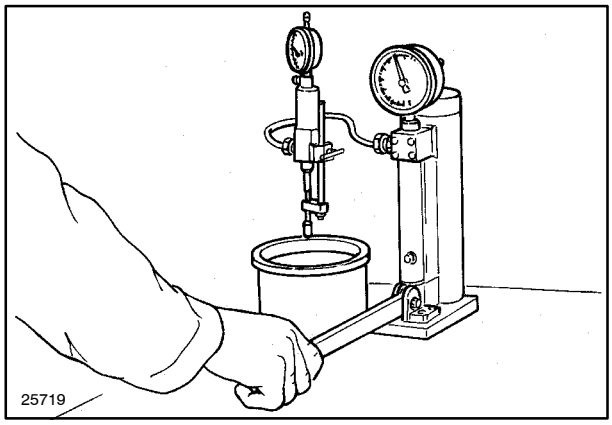
103

14. Operate the hand pump and at the same time tighten screw (1) on the tool until oil stops flowing out through the control valve block pin seat outlet.
15. Zero-set the dial gauge.
16. Tighten the screw (1) on the tool further to move the control valve block pin by 0.0708 to 0.0787 in. (1.8 to 2 mm), using the dial gauge to read this distance.



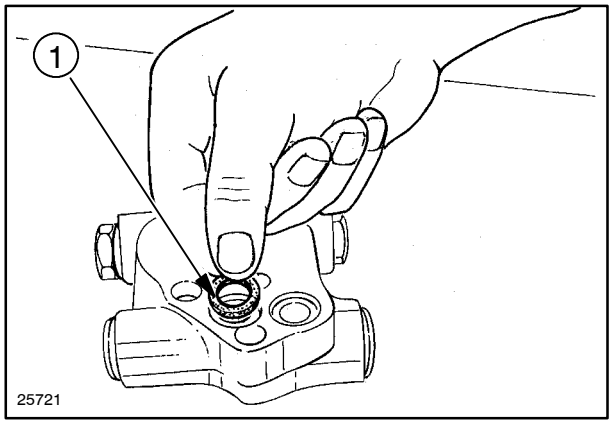
104

17. Operate the hand pump until the oil in the system is at an initial pressure of 3553.61 psi (245 bar). Using the pressure gauge, check that it takes more than six seconds for the pressure to fall 2842.88 psi (196 bar) to 1421.44 psi (98 bar). If it takes less than this time, replace the control valve block pin. Bear in mind that this part is supplied together with the relevant seat.



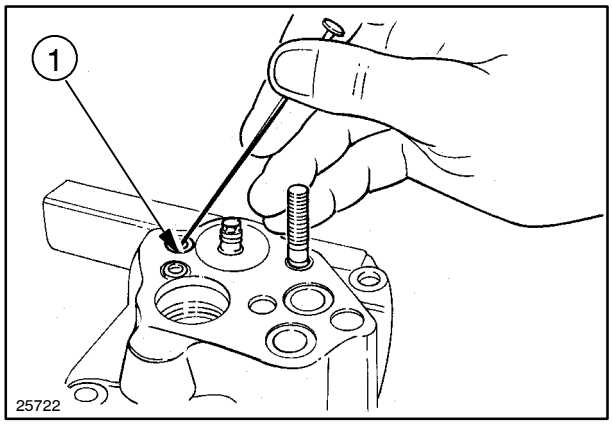
105

18. Check the control valve cover seals (1) and replace if necessary.



106

19. Check the control valve seals (1) and replace if necessary.
20. Check the arm descent speed control pin seal and replace if necessary, following the instructions in the note on page 11.
21. Check the cylinder pressure relief valve calibration as follows.



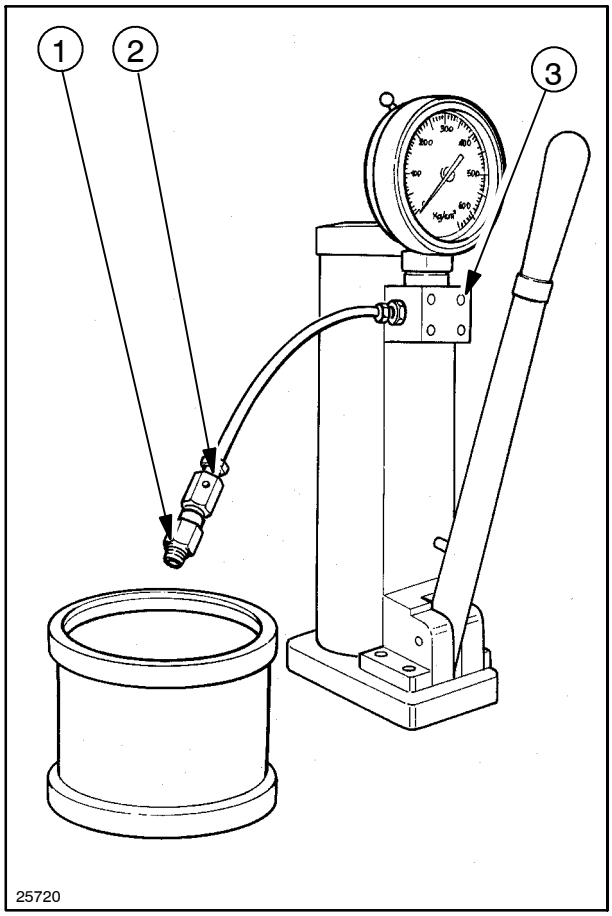
107

22. Fit the cylinder safety valve (1) on the valve union **380000218** (2) and connect to the hand pump **380000277** (3).
23. Operate the hand pump (3) and check that the cylinder safety valve opens at a pressure of 3045.95 to 3118.47 psi (210 to 215 bar). If the valve setting does not correspond to the prescribed value, it is best to change it immediately. If necessary it can be adjusted by turning the threaded cap, using wrench **380000230**. Tighten to increase the valve setting value or loosen to reduce the value.
24. To refit the hydraulic control valve block, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refer to the illustrations on page 11 for the correct orientation of the various parts;
- Respect the tightening torques prescribed on page 7.
- Fit the control valve block pin.
- Fit the non-return valve.
- Fit the cylinder safety valve.
- Fit the control valve.
- Fit the pressure control valve unit.
- Fit the cover on the control valve block.



108

NOTE: *Adjust the arms descent speed as follows:*

- fully screw on the adjusting pin;
- unscrew the pin by:
  3 to 3.5 turns for models TL70, TL80, TL90 and TL100.
  1 to 2 turns for models TL80, TL90 and TL100, fitted with the additional cylinder.
- secure with the relative locknut.

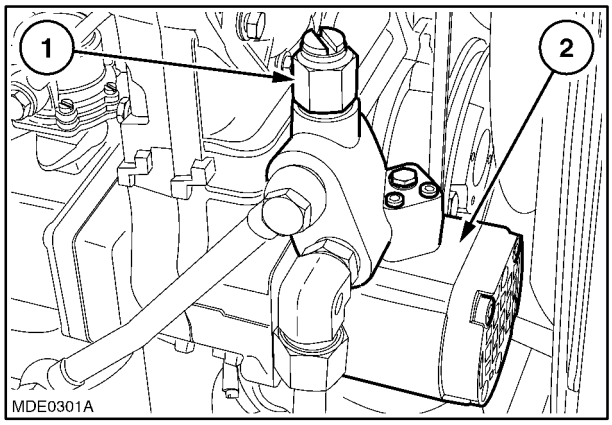
Op. 35 114 30
LIFT PRESSURE RELIEF VALVE R.I.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

On models fitted with BOSCH auxiliary control valves the lift pressure relief valve (1) is located on the lift pump (2).

If faulty, remove and change the valve.



109

Op. 35 114 32
LIFT PRESSURE RELIEF VALVE Setting

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

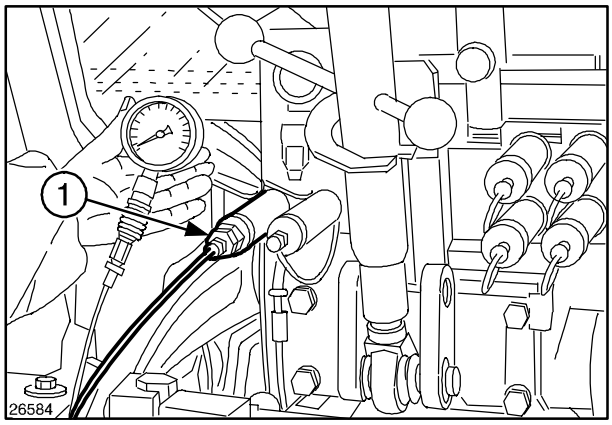
Proceed as follows.

1. Run the engine until the oil in the system reaches a temperature of approximately 122 °F (50 °C).

2. Insert the fitting **293449** (1) in a quick-fit female half-coupling and connect it to the 0 to 250 kg/ cm^2 scale pressure gauge, supplied with kit **380000240**.

3. Activate the half-coupling control valve block lever until the pressure relief valve cuts in.

4. With the engine running at medium speed the pressure gauge must show a pressure of about 2697.84 to 2770.36 psi (186 to 191 bar). If the valve setting does not correspond to the prescribed value, it is best to change it immediately. If necessary it can be adjusted by turning the threaded cap, using wrench **380000231**. Tighten to increase the valve setting value or loosen to reduce the value.



110

SECTION 35 - HYDRAULIC SYSTEMS

Chapter 2 - Open centre system auxiliary control valves

CONTENTS

Operation	Description	Page
	Data - Tools	1
	Tightening Torques	2
	Cross-sectional views	3
	Description and Operation	6
	Troubleshooting	see Lift - Chapter 1
35 204 46	Auxiliary control valves D.A.	10
35 204 46	Flow control valve D.A.	13

DATA

Filter	full-flow, with replaceable paper cartridge, (common to the hydraulic lift circuit)
Pump	gear pump (common to the hydraulic lift circuit see Chapter 1)
AUXILIARY CONTROL VALVES	
Location	valve stack up to a maximum of 5 control valves, 3 of which fixed to the cover of the gear control rod support and 2 on the support fitted on the right-hand side of the engine
Operating	by hand lever
Pressure release valve calibration psi (bar)	2755.86 to 2828.38 psi (190 to 195)
Type	convertible for operation of single or double-acting actuators, convertible for operation of single or double-acting actuators and with automatic detent release, convertible for operation of double-acting actuators with float control and automatic detent release, convertible for operation of double-acting actuators with float control.

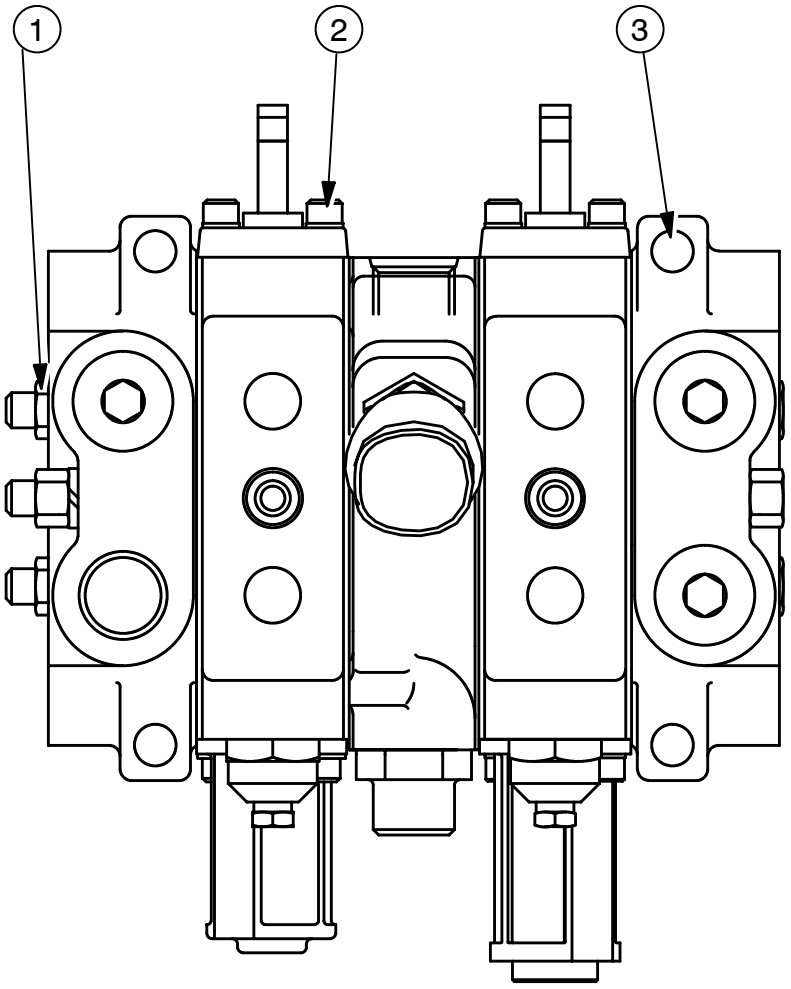
TOOLS

WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an (**X**) .To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

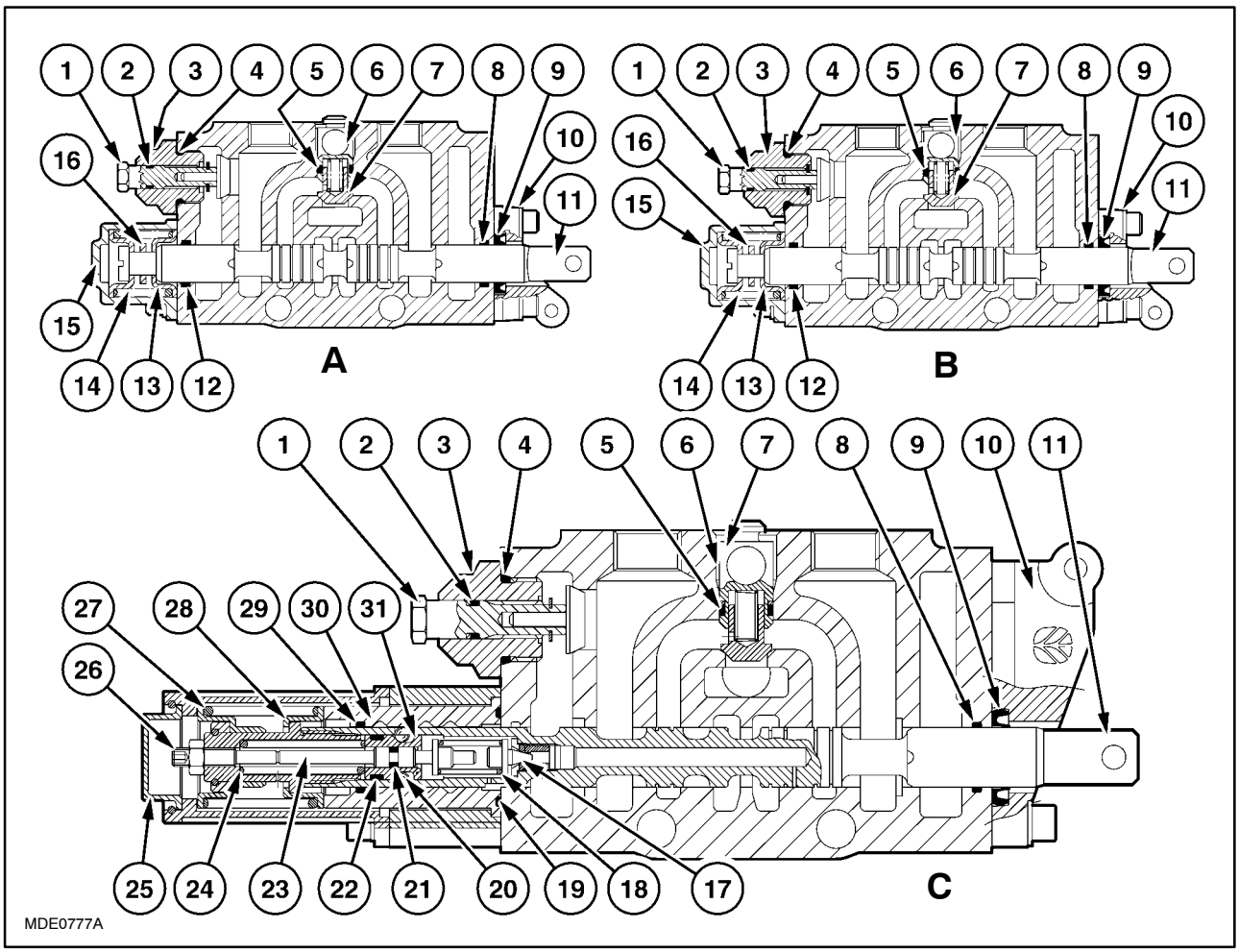
380000240	Universal pressure testing kit.
380000241	Seal guard for Kontak control valve single-acting valve.
380000701	Flow control valve adjustment tool.



1

TIGHTENING TORQUES

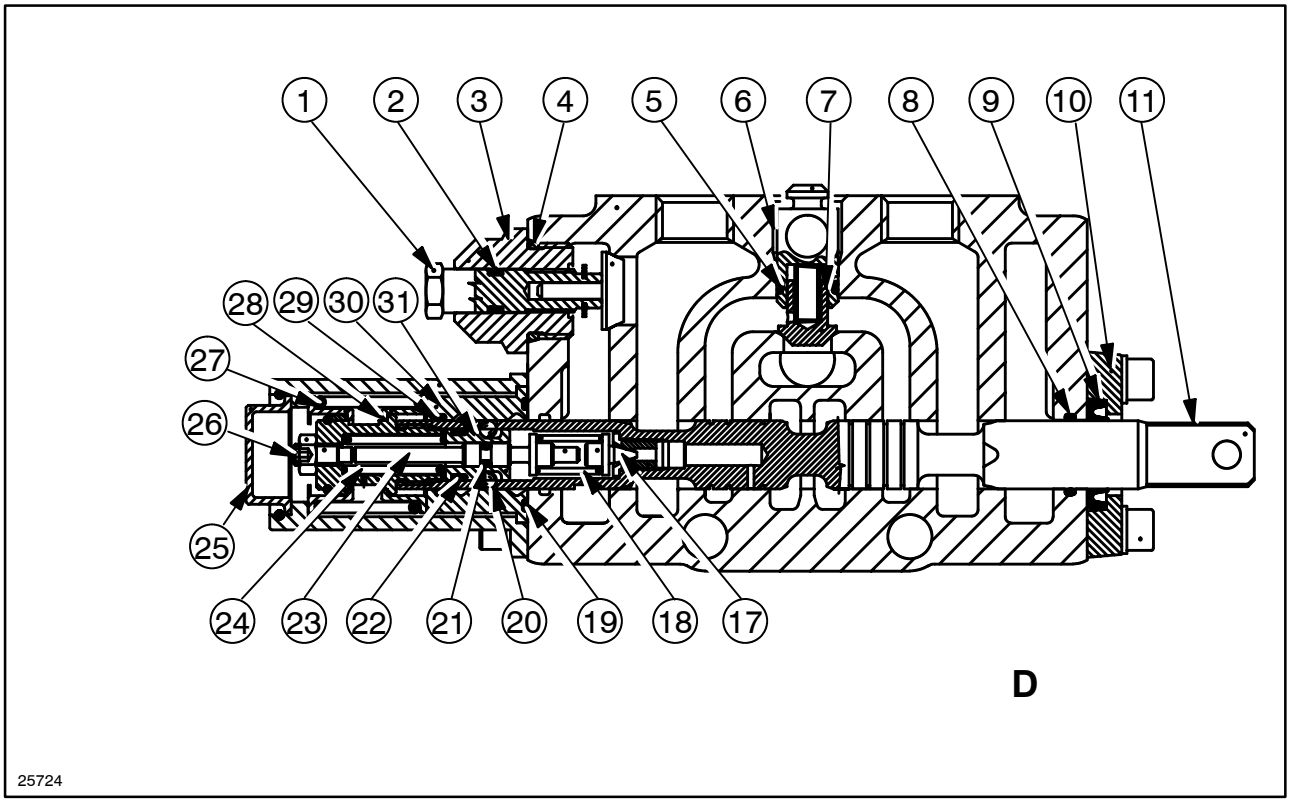
Parts to tighten	Thread	Tightening Torques	
Control valve element locknuts (1)	3/8" - 24 UNF	Nm 20.4	kgm 2.1
Front and rear cover retaining bolts (2)	1/4" - 20 UNC	Nm 11	kgm 1
Auxiliary control valve retaining bolts (3)	M 10 x 1.25	Nm 59	kgm 6



2

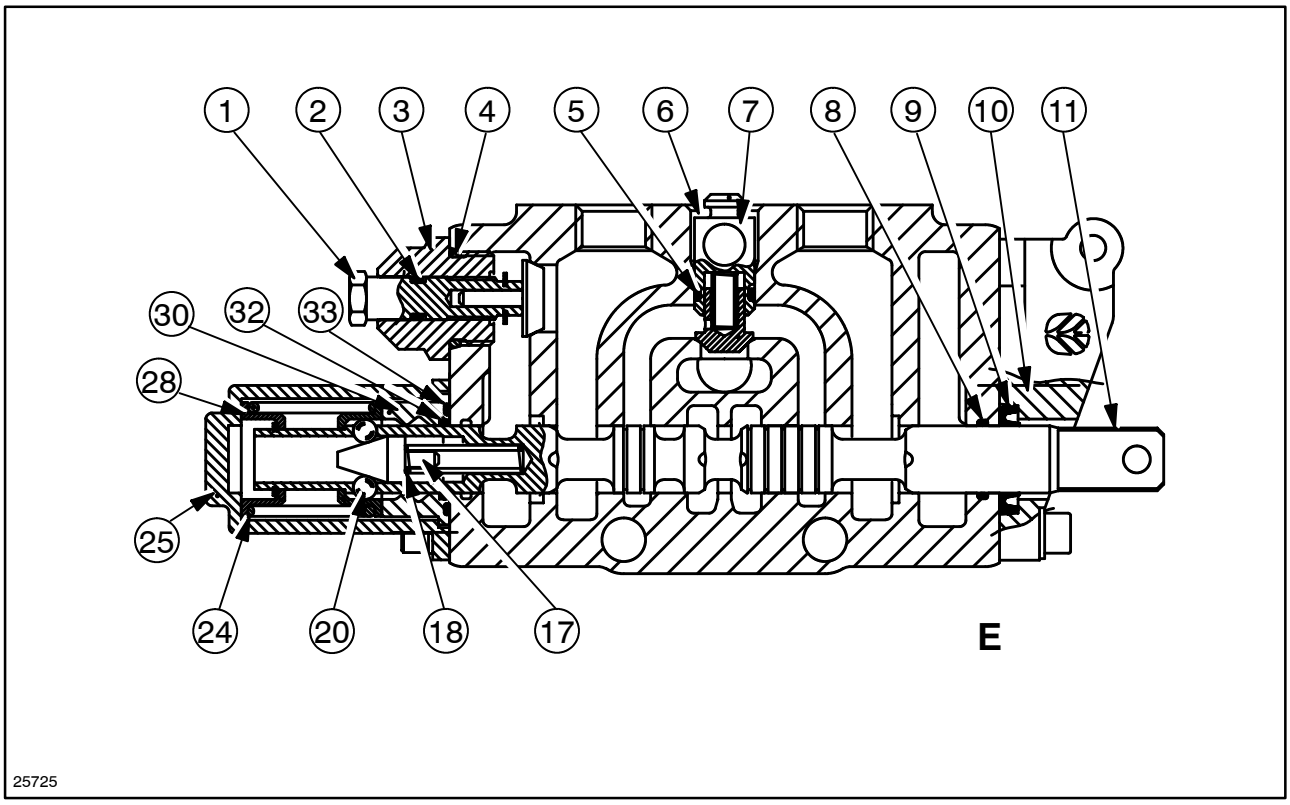
Auxiliary control valve cross-sectional views

A. Auxiliary control valve configured for operation of a double-acting cylinder.
B. Auxiliary control valve configured for operation of a single-acting cylinder.
C. Auxiliary control valve configured for operation of a single/double-acting cylinder with float control and automatic detent release.
D. Auxiliary control valve configured for operation of a single/double-acting cylinder with automatic detent release.
E. Auxiliary control valve configured for operation of a single/double-acting cylinder with switching float control.
1. Single/double-acting switching valve.
2. Seal.
3. Valve retaining plug.
4. Seal.
5. Seal.
6. Check valve seat.
7. Non-return valve.
8. Seal.
9. Seal.
10. Control support.
11. Control valve stem.
12. Seal.
13. Cup.
14. Control valve stem return spring.
15. Cover.
16. Spacer.
17. Tapered needle.
18. Spring.
19. Seal.
20. Detent balls.
21. Seal.
22. Seal.
23. Internal plunger.
24. Spring.
25. Cover.
26. Detent release pressure adjuster screw.
27. Control valve stem return spring.
28. Cup.
29. Seal.
30. Detent notch body.
31. Detent ball support.
32. Gasket.
33. Gasket.



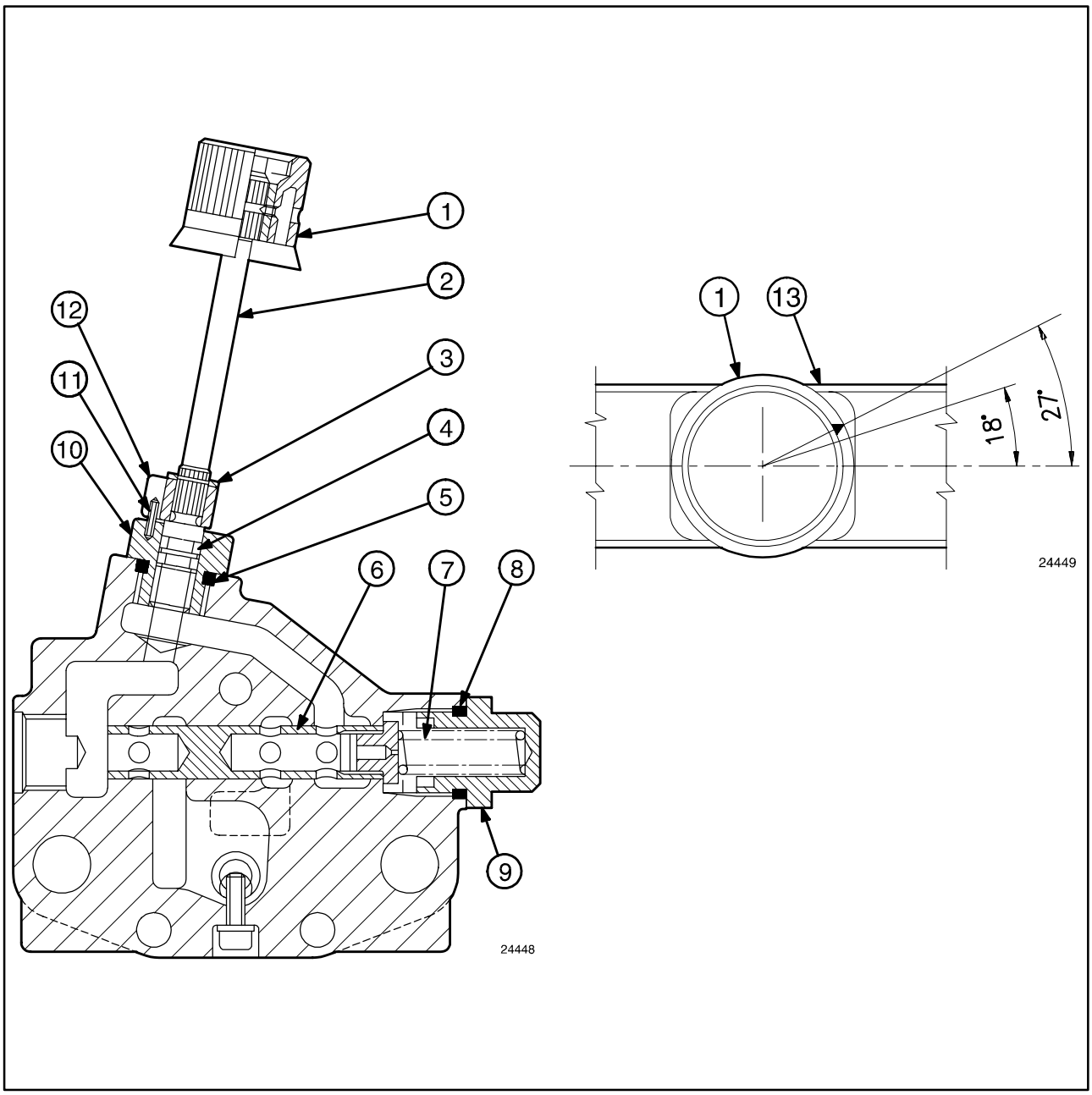
3

Single/double-acting auxiliary control valve with automatic detent release - cross-sectional view



4

Single/double-acting auxiliary control valve with switching float control - cross-sectional view



5

Cross-sectional view of flow control valve

1. Control pin knob.
2. Control pin.
3. Circlip.
4. Seal.
5. Seal.
6. Flow control valve.
7. Spring.
8. Seal.
9. Plug.
10. Control pin support cap.
11. Flexible pin.
12. Bushing with stop fin.
13. Flow control valve body.

DESCRIPTION AND OPERATION

The auxiliary control valves serve for control of hydraulic loads external to the tractor.

Up to a maximum of 5 auxiliary control valves can be fitted, fixing 3 on the cover of the gear control rod support and 2 on the support fitted on the right-hand side of the engine.

The rear auxiliary control valves are operated by the hand levers located on the right-hand side of the driving position, while the front auxiliary control valves on the right-hand side of the engine are operated by a joystick on the right-hand side of the mudguard.

The levers and respective control valves are identified by colour, as follows:

Lever colour	Control valve position	no.
Green	RH external	I
Blue	RH internal	II
Brown	RH central	III

Each control lever has three or four positions, depending on the type of control valve it operates.

1. **Lifting** - Pull the lever backwards to extend the connected cylinder and lift the implement.
2. **Neutral** - Push the lever forwards leaving the lifting position to select neutral and stop the flow of oil to the connected cylinder.
3. **Lowering** - Push the lever further forwards, beyond the neutral position, to return the cylinder and lower the implement.
4. **Float** - Push the lever beyond the "lowering" position to select the "float" function. This will allow the cylinder to extend or return freely, permitting implements (such as blades) to follow the profile of the terrain.

The auxiliary control valves on the right-hand front side of the tractor are operated with the joystick.

Moving the joystick lengthways operates the second front auxiliary control valve, crossways it acts on the first front auxiliary control valve.

The joystick has the advantage of being able to operate two auxiliary control valves simultaneously.

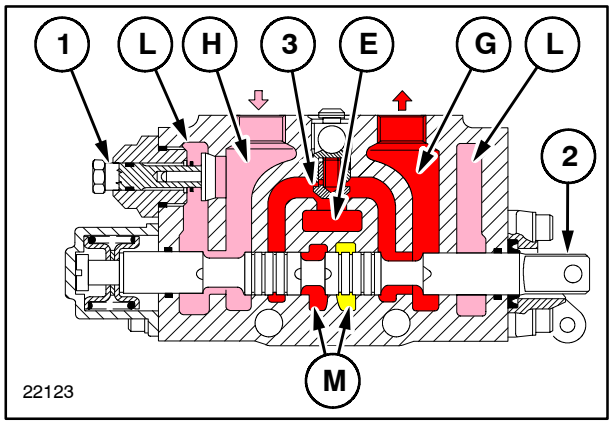
The flow control valve, on tractors fitted with auxiliary control valves located on the right-hand front side of the tractor, is installed between the first and second control valve.

The flow control valve can be used to change the flow rate of oil to the front control valve. Turning the control knob anticlockwise decreases the flow rate, whereas turning it clockwise increases it.

The operation of the hydraulic control valves is described on pages 7, 8 and 9.

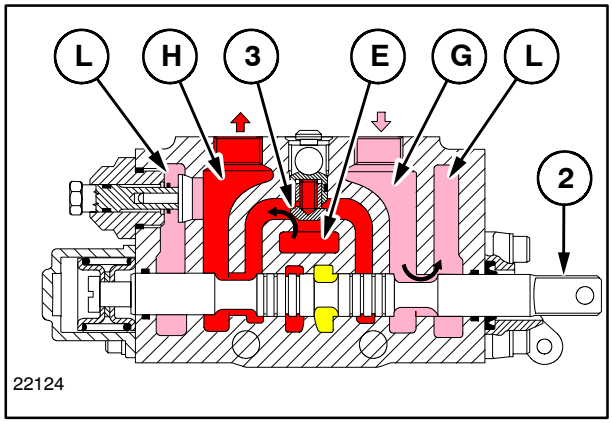
OPERATING STAGES OF AUXILIARY CONTROL VALVE FOR THE OPERATION OF A DOUBLE-ACTING CYLINDER (FIGS. 6 AND 7) AND A SINGLE-ACTING CYLINDER (FIGS. 8 AND 9)

1. LIFTING - On pulling back the control lever (located in the cab) the control valve stem (2, fig. 6) shifts to connect the cylinder bottom chamber with the delivery line (E) by way of the check valve (3) and line (G) and also the cylinder top chamber with the exhaust line (L) by way of line (H), intercepting the supply of oil to the lift control valve. Keep the lever pulled back, to extend the cylinder to its full stroke; on releasing the lever it will automatically return to the neutral position under the action of the return spring, and the entire flow from the pump will be conveyed to the lift control valve by way of lines (M).



6

2. LOWERING - To lower the implement, push the control lever (located in the cab). The control valve stem (2) will shift to the position indicated in fig. 7 thus allowing the oil in the lower cylinder chamber to flow to the exhaust (L) through the line (G), while the upper chamber is connected to the delivery line (E) through line (H) and check valve (3).



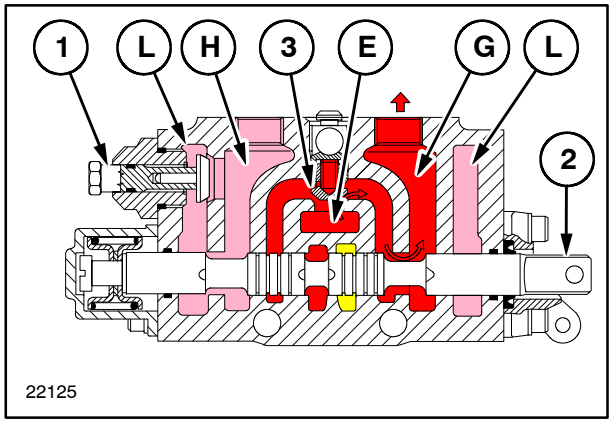
7

3. LIFTING - On pulling back the control lever (located in the cab) the control valve stem (2, fig. 8) shifts to connect the cylinder with the delivery line (E) by way of the check valve (3) and line (G). Line (H), for the control of double-acting cylinders, is not used at this stage as it is permanently connected to the exhaust (L) by the open position of the switching valve (1).

Pressurised oil

Oil in suction, delivery or exhaust

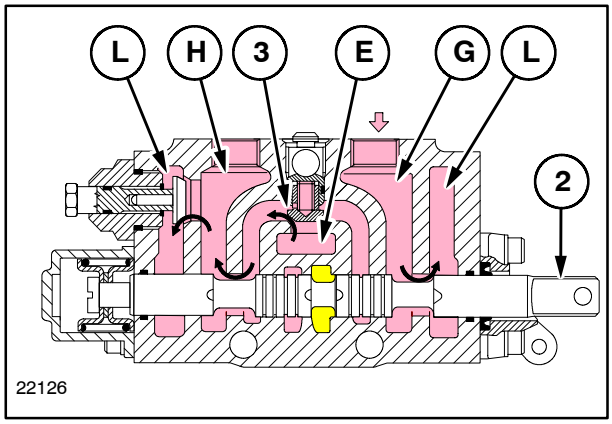
Static oil



8

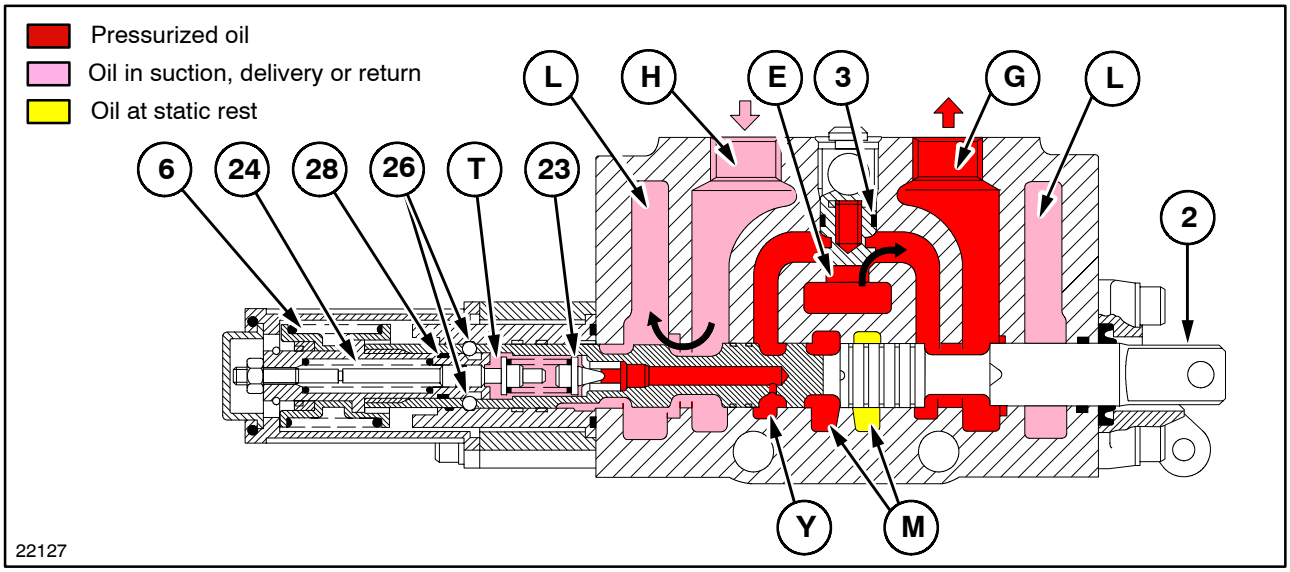
4. LOWERING -On pushing back the control lever (located in the cab) the stem (2) will shift to the position indicated in fig. 9. The oil contained in the cylinder, pressurised by the weight of the lifted implement, will flow to the exhaust (L) by way of line (G), while the entire flow from the pump is also conveyed to the exhaust (L) through the check valve (3) and line (H).

NOTE: *To govern a double-acting cylinder you need to fully screw in the screw (1); to govern a single-acting cylinder you need to unscrew it.*



9

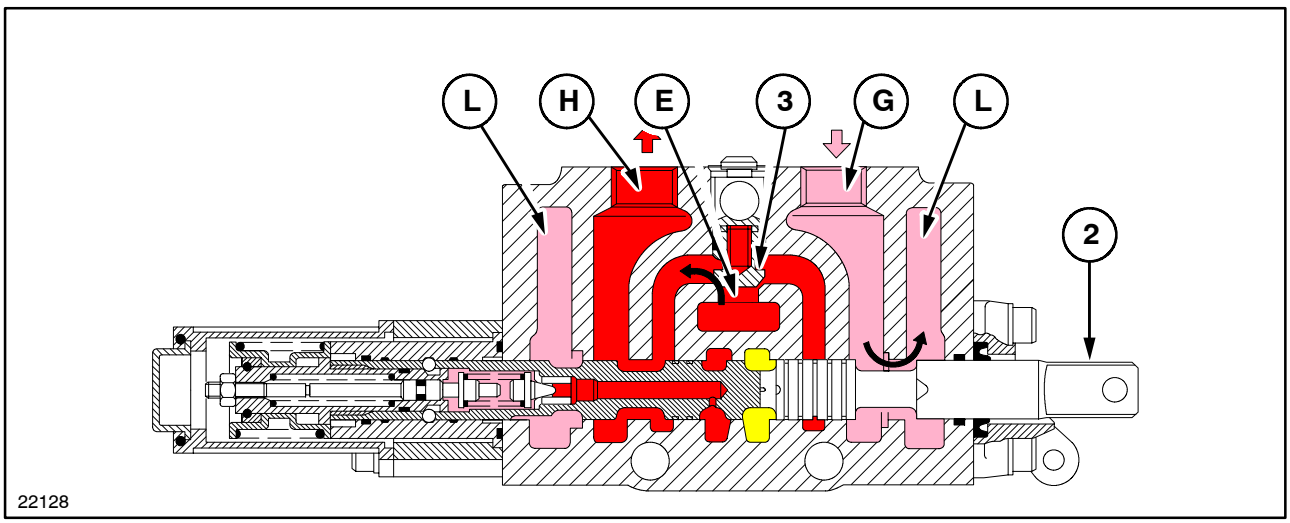
OPERATING STAGES OF AUXILIARY CONTROL VALVE FOR THE OPERATION OF A SINGLE/ DOUBLE-ACTING CYLINDER WITH AUTOMATIC DETENT RELEASE AND FLOAT POSITION



10

LIFTING

On pulling back the control lever (located in the cab), the control valve stem (2) shifts and the detent balls (26) engage the left hand groove, where they are held in place by the support (28) and spring (24). The movement of the stem (2) connects: delivery line (E) with the lower chamber of the cylinder, by way of the check valve (3) and the line (G), and also the upper cylinder chamber with the exhaust line (L) by way of line (H), intercepting the supply of oil to the hydraulic lift control valve. On completion of the lifting movement, the oil pressure increases to 2465.77 to 2538.29 psi (170 to 175 bar), acting through the port (Y), it overcomes the resistance of the spring of the tapered cap (23). Inside chamber (T) the oil pressure increases and, acting on the support (28), it overcomes the resistance of the spring, thus moving the support (28). In this condition the two detent balls (26) drop onto the support (28), releasing the stem (2) which, under the action of the spring (6), returns to the neutral position, and consequently the entire flow from the pump is conveyed to the lift control valve through lines (M).

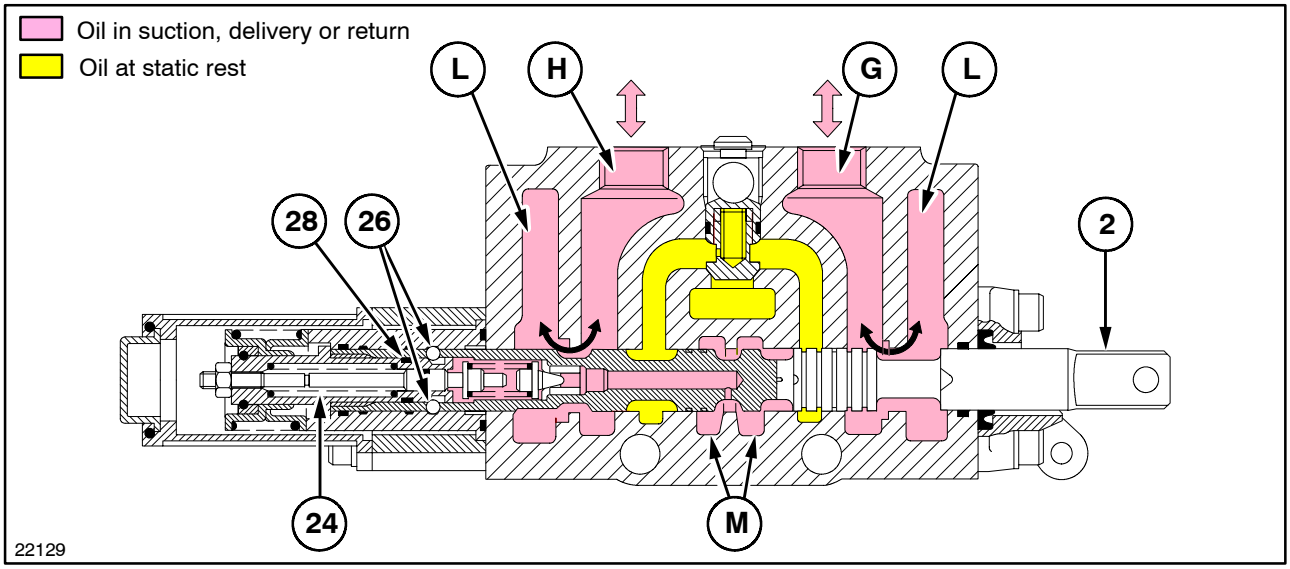


11

LOWERING

To lower the implement, push forward the control lever (in the cab). The control valve stem (2) shifts and the detent balls (26) engage in the central groove where they are held in position by the support (28) and the spring (24). In this condition the oil contained in the lower chamber of the cylinder can flow to the exhaust (L) by way of line (G), while the upper chamber is connected with the delivery (E) by way of line (H) and check valve (3). On completion of the lowering operation, the detent will be automatically released in the manner described previously.

OPERATING STAGES OF AUXILIARY CONTROL VALVE FOR THE OPERATION OF A SINGLE/ DOUBLE-ACTING CYLINDER WITH AUTOMATIC DETENT RELEASE AND FLOAT POSITION



12

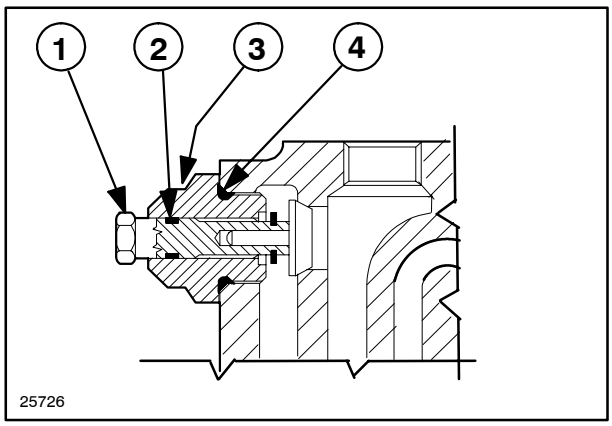
FLOAT OPERATION

For float operation push forward the control lever (in the cab). The control valve stem (2) shifts and the balls (26) enter the right-hand groove, held in place by the support and spring (24). In this position the stem (2) connects: the two lines (M) providing the lift control valve with the entire pump flow and the two exhaust lines (L), by way of lines (H, G) respectively with the upper and lower chambers of the cylinder. In this condition the only force exerted on the implement will be that created by its own weight, thus allowing the implement to follow the profile of the terrain and permitting the hydraulic lift to be used. With float operation the automatic detent release function is excluded, as there will be insufficient pressure in the auxiliary control valve.

Single/double-acting switching valve (of control valve fig. 10 - 11 - 12)

1. Single/double-acting switching valve.
2. Seal.
3. Valve retaining plug.
4. Seal.

NOTE: *To govern a double-acting cylinder you need to fully screw in the screw (1); to govern a single-acting cylinder you need to unscrew it.*



13

Op. 35 204 46
AUXILIARY CONTROL VALVES D.A.
with the unit removed

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

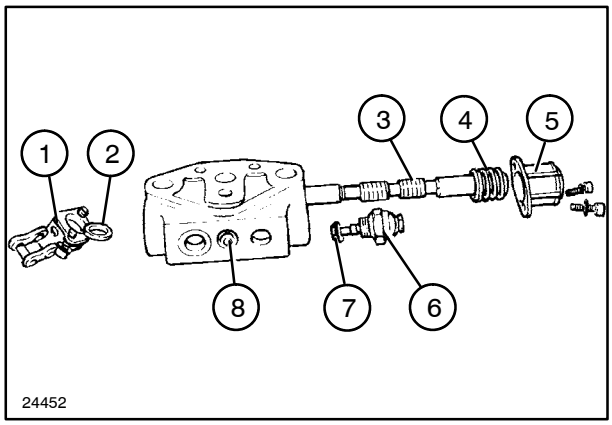
CAUTION

Always use appropriate tools to align fixing holes.
NEVER USE FINGERS OR HANDS.

Convertible single/double acting auxiliary control valve.

Disassemble the auxiliary control valve into its component parts, referring to fig. 2 and the following instructions:

1. Remove the cover (5), recover the spring (4) and the relative cup.
2. Extract the control valve stem (3).
3. Remove the control lever support (1) and recover the seal (2).
4. Remove the plug (6) and recover the single/double action switching valve (7).
5. Remove the valve housing (8) and recover the check valve and relative spring.
6. Check the condition of the seals before assembly.

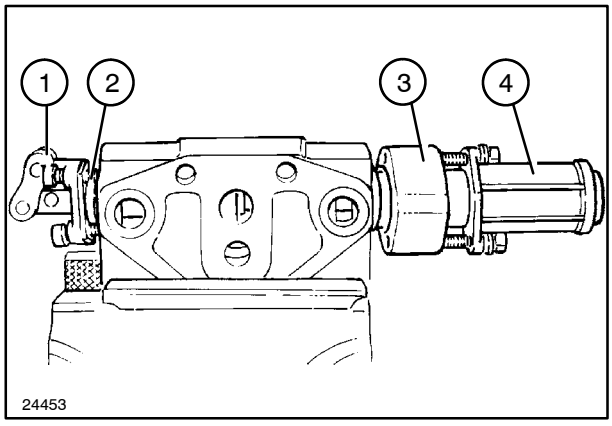


14

Single/double-acting auxiliary control valve with float control and automatic detent release.

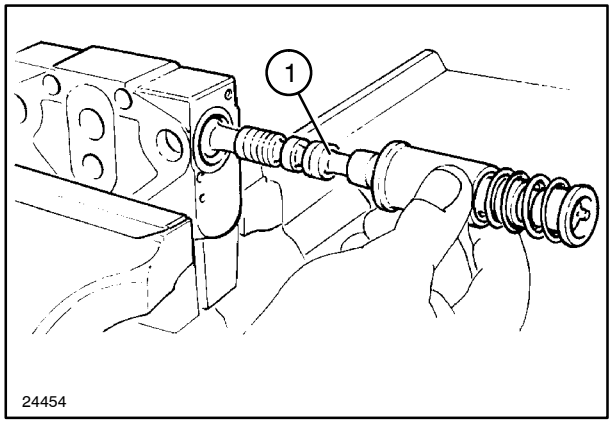
Disassemble the auxiliary control valve into its component parts, referring to fig. 2 and the following instructions:

1. Take out the retaining bolts, remove the cover (4) and the spacer (3).
2. Take out the retaining bolts and remove the control lever support (1) and its seal (2).



15

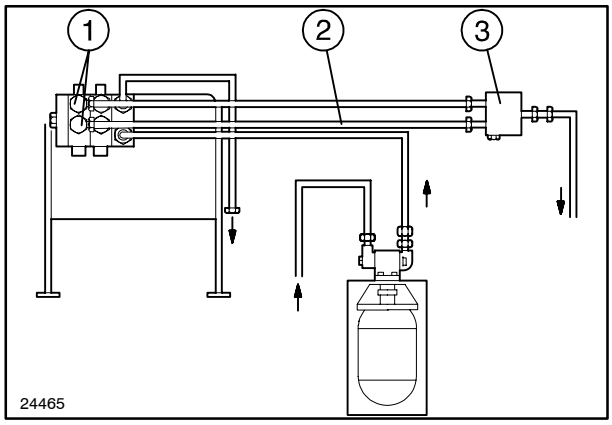
3. Extract the control valve stem (1).
4. Remove the valve housing and recover the check valve and spring.
5. Check the condition of the seals before assembly.



16

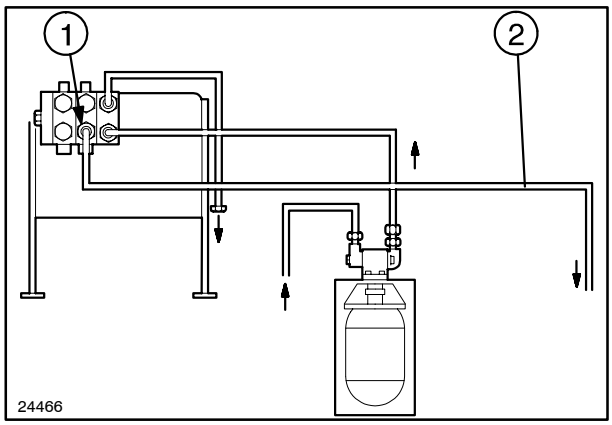
Diagram showing the installation of the tools and equipment required for the stem sticking test for control valves configured for double-acting operation (fig. 17) and control valves configured for single-acting operation (fig. 18).
Control valve stem sticking test (figs. 17 and 18).

NOTE: *With a test appliance filled with oil type ISO VG 68, DIN 51524/51525, the following tests must be performed at a temperature of approximately 140 °F (60 °C) and a flow rate of 12.5 litres/min., which can be obtained by having the motor turn at the highest speed (1450 rpm).*



17

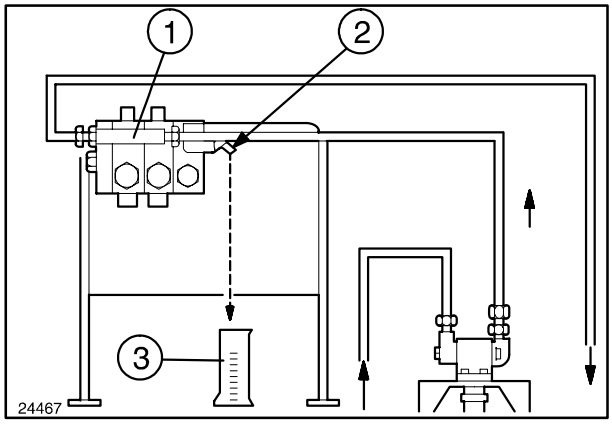
Install the auxiliary control valve assembly and the test equipment as indicated in the diagrams (figs. 17 and 18) and consider that:
- on control valves configured for double-acting operation (fig. 17), the two cylinder delivery ports must be connected to the ball connector (3) by way of the pipes (2) and unions (1);
- on control valves configured for single-acting operation (fig. 18), the return line (2) must be connected, by way of the union (1), to the delivery port on the control valve (port located opposite to the switching valve).



18

After having made the connections as indicated in the diagram, carry out the test as follows:
- start the hydraulic pump and operate the hand lever to move the control valve stem (in both directions for double-acting control valves);
- gradually increase the pressure by turning the handwheel on the test equipment, checking on the pressure gauge that the pressure reaches 2494.78 psi (172 bar). In this condition the control valve stem should slide normally and return to the neutral position the moment the hand lever is released;
- repeat the test on the other control valves after making the appropriate connections.

Diagram showing the installation of the tools and equipment required for the control valve stem leakage test



19

Control valve leakage test

Install the auxiliary control valve stack and the test equipment as indicated in the diagram (fig. 19) bearing in mind that the 3-way union (1) must be connected to single and double acting control valves using suitable adapters.

After having made the connections indicated in the diagram, carry out the test as follows:

- start the hydraulic pump and gradually increase the pressure by turning the handwheel on the test equipment until a pressure of 2132.16 psi (147 bar) is shown on the pressure gauge;
- collect the leaked oil flowing from the union (2), in the burette provided (3) for a period of exactly one minute. Check that the quantity of oil collected does not exceed 25 cm^3/minute in the case of a new control valve, or 60 cm^3/minute for a used control valve.

Repeat the test on each control valve, checking alternately the two delivery lines to the user cylinder.

ADJUSTMENT OF THE AUTOMATIC DETENT RELEASE PRESSURE

Connect the control valve to the test equipment.

Start the hydraulic pump and tighten the release pressure adjuster screw (26, fig. 2) until a pressure of 2465.77 to 2538.29 psi (170 to 175 bar) is obtained in front of the tapered cap (17).

Lock the screw (26) in position by tightening the locknut.

Op. 35 204 46
FLOW CONTROL VALVE D.A.
with the unit removed

CAUTION

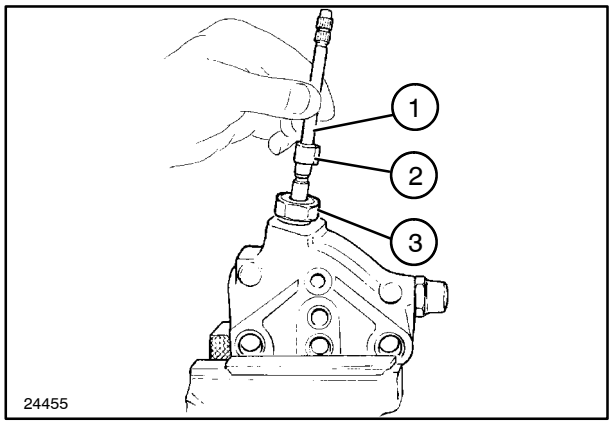
Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

CAUTION

Always use appropriate tools to align fixing holes.
NEVER USE FINGERS OR HANDS.

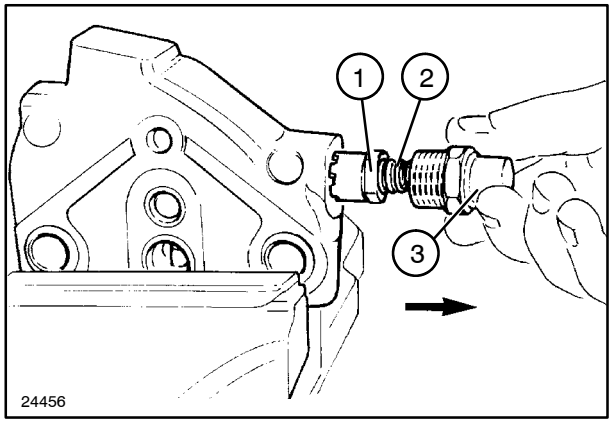
Proceed as follows:

1. Remove the circlip, raise the finned bushing (2), unscrew the control pin (1) and remove the seat (3) of the pin (1).



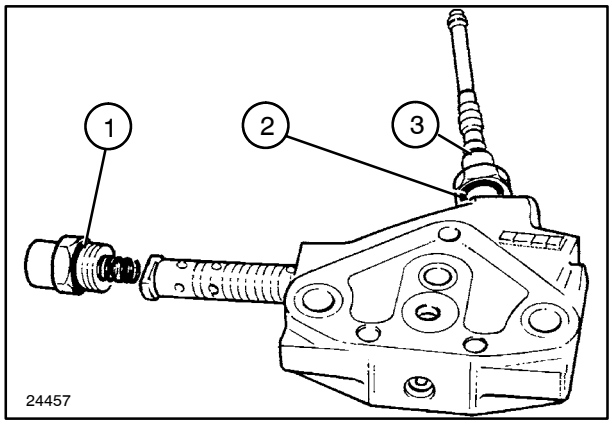
20

2. Remove the plug (3), spring (2) and valve (1).



21

3. Check the condition of the seals (1, 2 and 3) before reassembling the unit.



22

FLOW CONTROL VALVE

Machine flow control adjustment

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

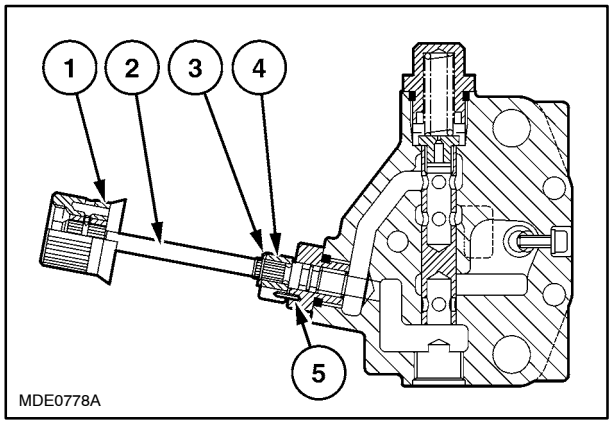
CAUTION

Always use appropriate tools to align fixing holes.
NEVER USE FINGERS OR HANDS.

Adjustment must be carried out with the engine switched off.

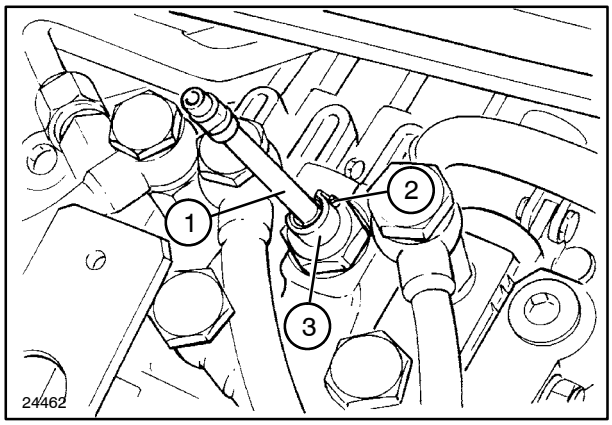
Proceed as follows:

1. Take out the retaining bolt and remove the knob (1) from the pin (2) governing the flow control valve.
2. Remove the circlip (3) and the finned bushing (4).



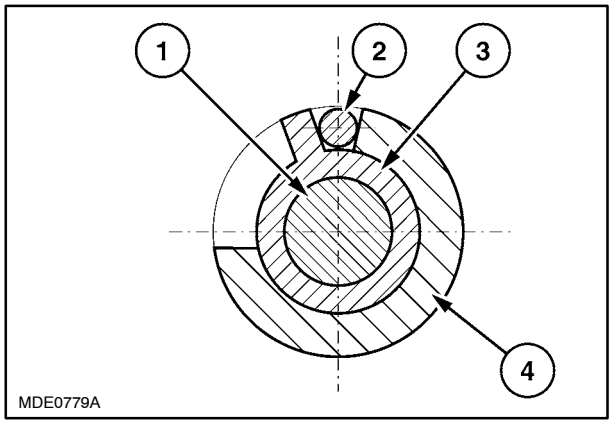
23

3. Screw down the control pin (1) bringing it up against the limit stop without forcing.
4. Position the finned bushing (3) in contact with the stop pin (2) as shown in the figure. If this does not occur, slightly unscrew the pin (1) to make simultaneous contact possible of the fin of the bushing (3) with the pin (2) and the coupling of the teeth on the parts (1) and (3).



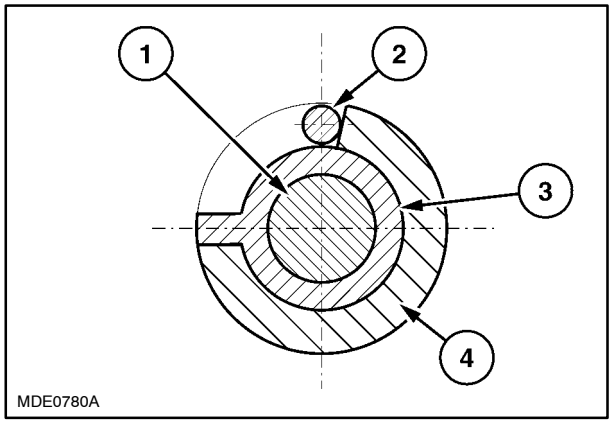
24

5. Position tool **380 000 701** (4) in contact with the stop pin (2) on the opposite side of the fin on the bushing (3).



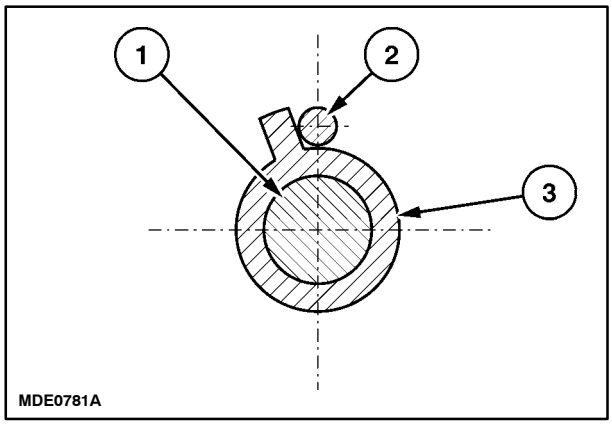
25

6. Turn the control pin (1) until the fin on the bushing (3) makes contact with the tool **380000701** (4) as shown in the figure.
7. Keeping the control pin (1) stationary, extract the tool **380000701** (4) and the finned bushing (3).



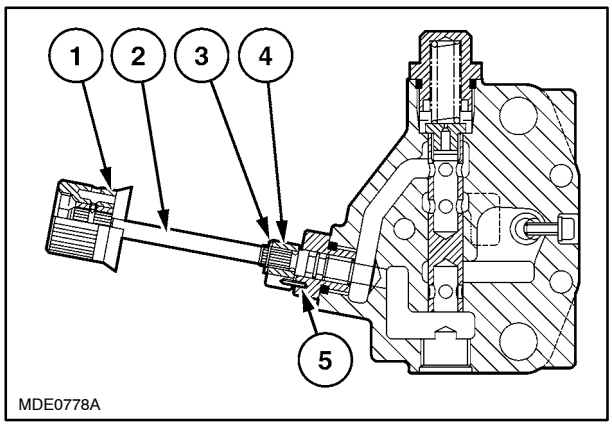
26

8. Keeping the control pin (1) stationary, put the finned bushing (3) back onto the pin (1) so that the fin is in contact with the stop pin (2) as shown in the figure.
   If this does not occur, slightly unscrew the pin (1) to make simultaneous contact possible of the fin on the bushing (3) with the pin (2) and the coupling of the teeth on the parts (1) and (3).
9. Secure the bushing (4) with the circlip (3).



27

10. Position the knob (1) so that the pointer is in the "max" zone (on the guard) with the pin (2) fully unscrewed, and in the "min" zone when the pin (2) is fully tightened (when in this position, check that the pointer is located between angles 18° to 27° shown in fig. 5).
    Lock the knob (1) with the screw.



28

NOTE: *This adjustment should be considered approximate; if perfect adjustment is required carry out hydraulic calibration on a workbench. Proceed as follows.*
AMBRA MULTI G *test oil at a temperature of 122 °F (50 °C).*
Connect the control valve to the pump, fully tighten the control pin, without forcing.
Unscrew the control pin to obtain a flow rate, on the right-hand outlet (looking at the valve from the side of the plug) (9, fig. 5), as indicated in the following table.

Flow rate sent by the pump to the valve l/min (dm^3/min)	Flow rate to obtain at valve outlet l/min (dm^3/min)
25	7 to 8
30	7,2 to 8.2
35	7,3 to 8.3
40	7,4 to 8.4
45	7,6 to 8.6
50	7,8 to 8.8
55	8 to 9

SECTION 35 - HYDRAULIC SYSTEMS

Chapter 3 - Auxiliary control valves for remote control (BOSCH)

CONTENTS

Operation	Description	Page
	Data	2
	Tools	2
	Tightening Torques	3
	Description and Operation	4
	Auxiliary control valve components	6
	Control valve inter-connection	10
	Lifting oil flow (Cylinder extension)	11
	Lowering oil flow (Cylinder retraction)	13
	Neutral oil flow	14
	Float mode oil flow	15
	Automatic release pressure regulating valve operation	16
	Operation of two or more control valves simultaneously	17
35 204 40	Auxiliary control valves R.I.	19
35 204 46	Auxiliary control valves. D.A.	22

DATA

Location		groups of 2 or 3 control valves
Operating		by hand lever
Nominal flow rate	l/min	70
Maximum flow rate	l/min	80
Automatic release valve calibration	psi (bar)	175
Pressure release valve calibration	psi (bar)	2755.86 to 2828.38 (190 to 195)
Control valve types		single and double-acting, with automatic release and float mode.

TOOLS

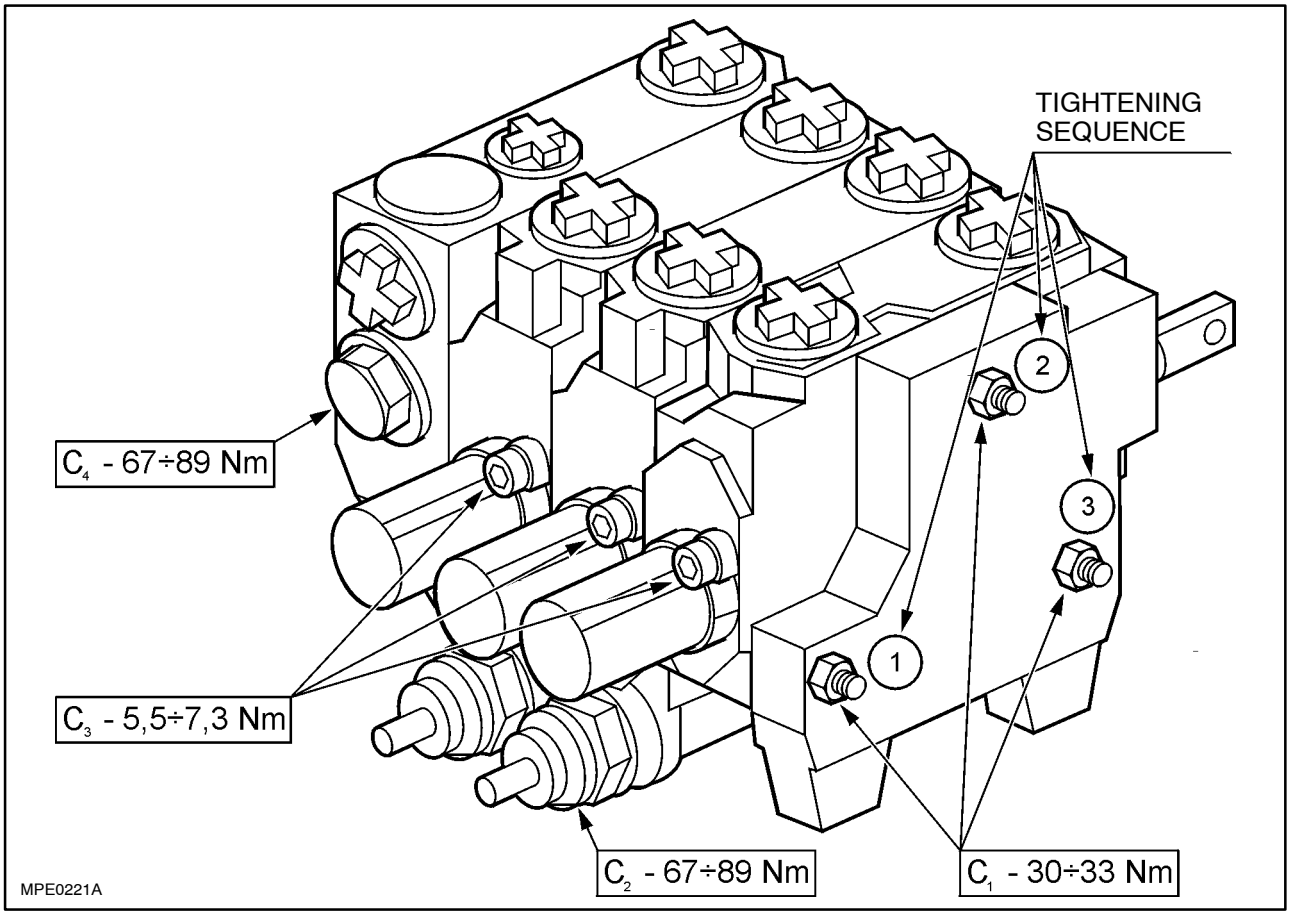
Warning - The operations described in this section can only be carried out with **ESSENTIAL** tools indicated by an **(X)**.

To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

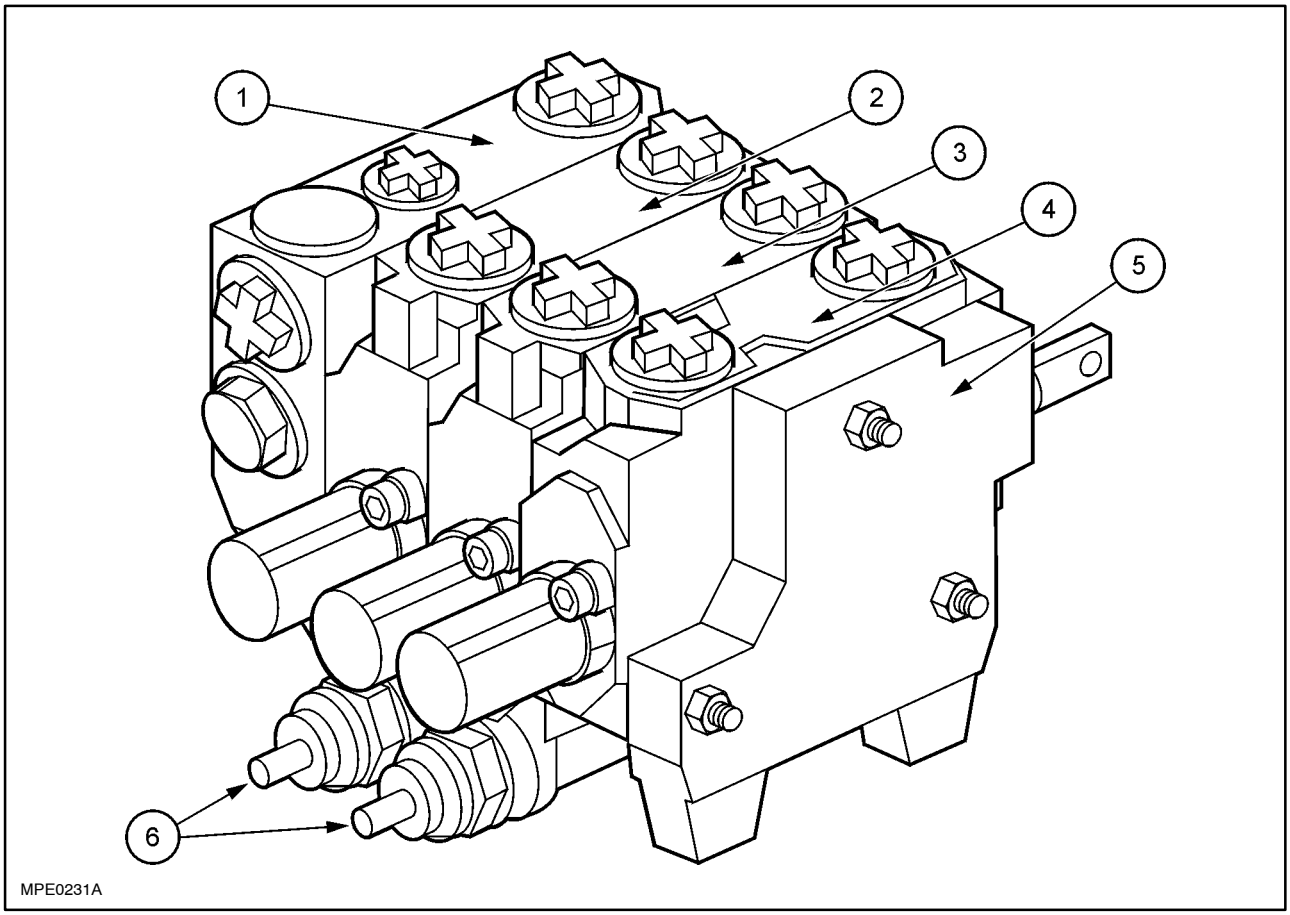
380000240 Universal pressure testing kit.

TIGHTENING TORQUES



1

Parts to tighten	Thread	Tightening Torques	
		Nm	Kgm
Control valve elements locknuts (C_1)	M 8 x 1.25	30 to 33	3 to 3.4
Control valve locknuts (C_2)	M 22 x 1.5	67 to 89	6.8 to 9.1
Front and rear cover retaining bolts (C_3)	M 6 x 1	5.5 to 7.3	0.6 to 0.75
Blanking plug (C_4)	M 22 x 1.5	67 to 89	6.8 to 9.1



2

Auxiliary control valve unit

1. Connecting plate
2. Third auxiliary control valve
3. Second auxiliary control valve
4. First auxiliary control valve
5. End plate
6. Flow control valve adjuster

DESCRIPTION AND OPERATION

The auxiliary control valves serve for control of hydraulic loads external to the tractor.

Up to a maximum of 3 auxiliary control valves can be fitted.

The rear auxiliary control valves are operated by the hand levers located on the right-hand side of the driving position.

The levers and respective control valves are identified by colour, i.e.: a lever in a specific colour will operate the control valve and engagement half-coupling of the same colour.

Each control lever has three or four positions, depending on the type of control valve it operates.

1. **Lifting** - Pull the lever towards the operator to extend the connected cylinder and lift the implement.
2. **Neutral** - Push the lever away from the operator, leaving the lifting position, in order to select the neutral position and deactivate the connected cylinder.
3. **Lowering** - Push the lever further away from the operator, beyond the neutral position, to return the cylinder and lower the implement.
4. **Float mode** - Push the lever away from the operator, beyond the lowering position to select the "float" function. This will allow the cylinder to extend or return freely, permitting implements (such as blades) to follow the profile of the ground surface.

The operation of the hydraulic control valves is described on the following pages.

The main hydraulic components inside each of the auxiliary control valves are:

Flow control valve adjustment (1, fig. 3)

Flow control valve adjustment is carried out manually and controls the oil flow by means of the auxiliary control valve.

By turning the adjuster, the oil flow throttle clearance is varied by means of the flow control valve.

Flow control valve (2, fig. 3)

The flow control valve reads the throttle pressure differential with the relative adjuster, and controls the flow by means of the auxiliary control valve.

As each flow control valve individually reads the pressure differential of the operating auxiliary control valve, two or more circuits can be simultaneously controlled by working at different pressures.

Load check valve (3, fig. 3)

The check valve impedes pressure backflow from the auxiliary control valve circuit when the control pin is activated and the pump system pressure is less than the counterpressure in the circuit.

The following example explains operation:

When a cylinder is under a consistent load and the control valve pin is moved from the neutral position to the lifting position, the pump pressure could be less than the counterpressure in the auxiliary control valve circuit.

In this event, the counterpressure would force the oil back into the circuit, momentarily reducing the load, before the pressure in the system increases to maintain and further lift the load.

The load check valve prevents this from happening.

Lockout valve (5, fig. 3)

The lockout valve is located in the auxiliary control valve lifting duct and is closed when the valve is in neutral.

The valve prevents the implement from returning spontaneously, in the event of the pin grooves leaking when in the neutral position.

The lockout valve opens automatically when the control valve pin is moved from the neutral position.

Control valve pin (4, fig. 3)

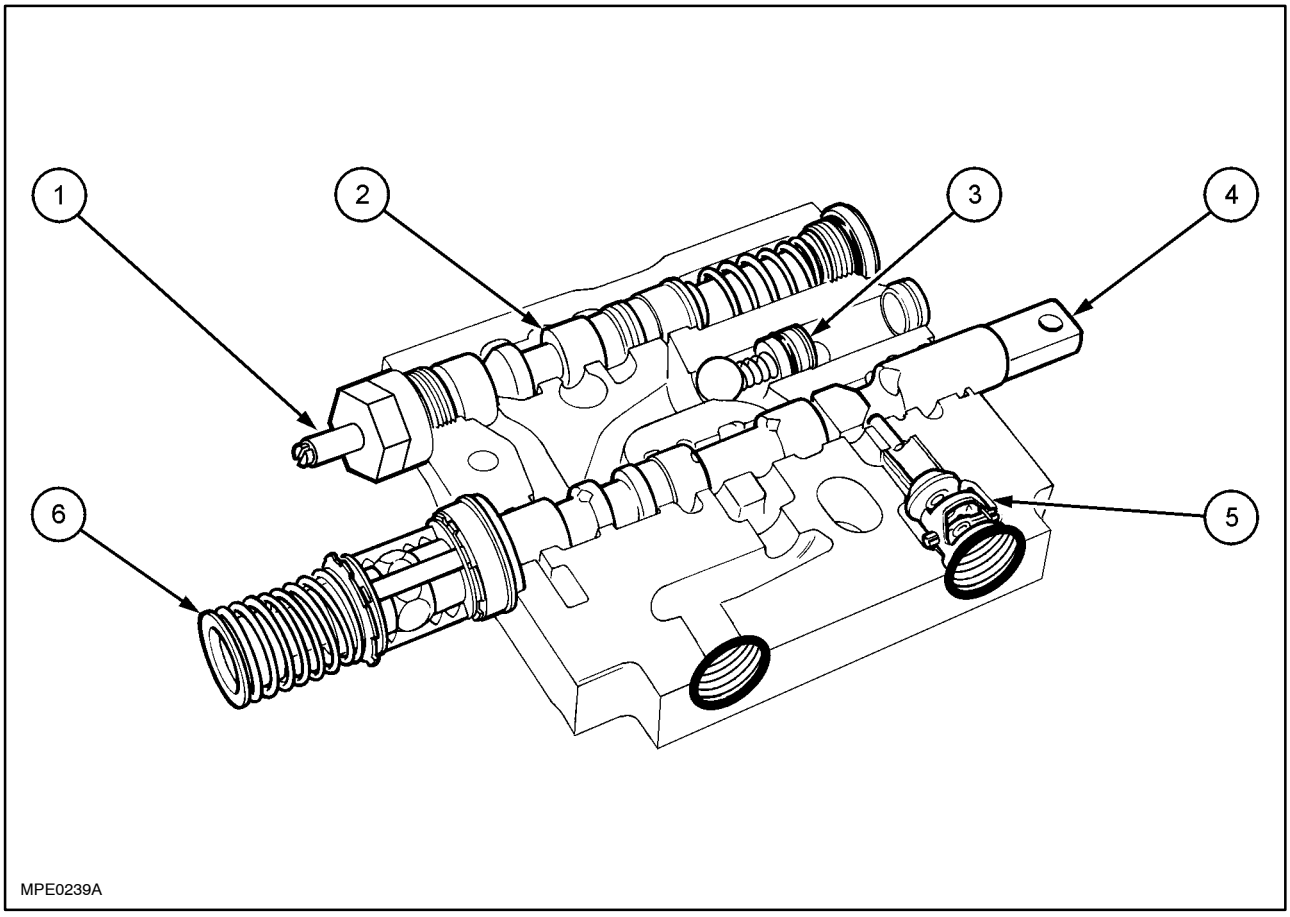
The control valve pin is kept centred in neutral; when it moves, it sends the flow of oil to the control valve lifting or lowering orifices.

Pin centering and automatic release mechanism (6, fig. 3)

The spring centering mechanism holds the control valve pin in the neutral position.

When the pin is moved to the lifting, lowering or float mode position, the mechanism holds the pin in position by means of two ball bearings that engage in a groove inside the control retainer.

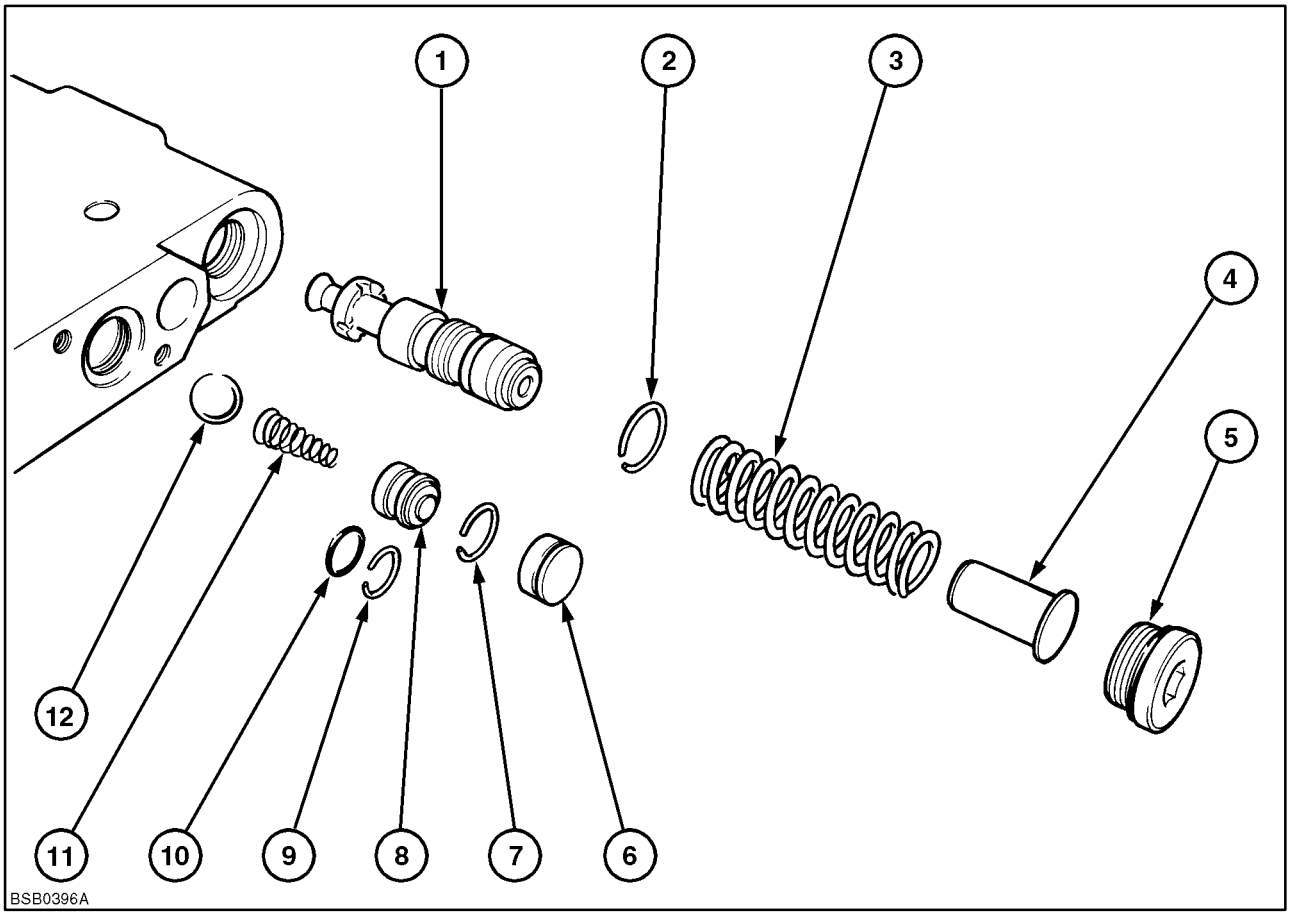
A pre-set release valve automatically releases the ball bearings, returning the pin to the neutral position each time the working pressure exceeds the predefined value.



3

Auxiliary control valve components

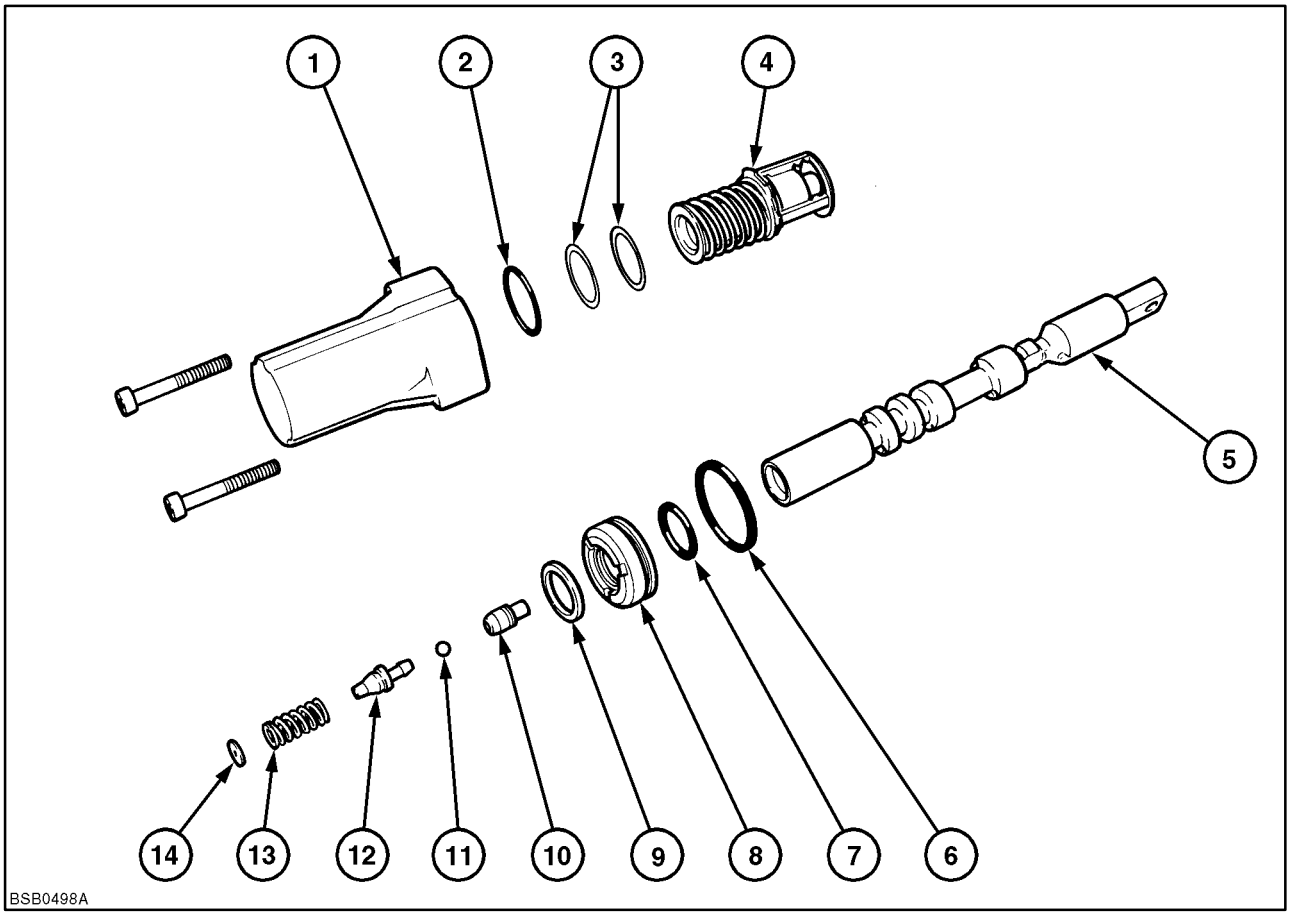
1. Flow control valve adjustment
2. Flow control valve
3. Load check valve
4. Control pin
5. Lockout valve
6. Pin centering mechanism



4

Flow control valve and check valve components

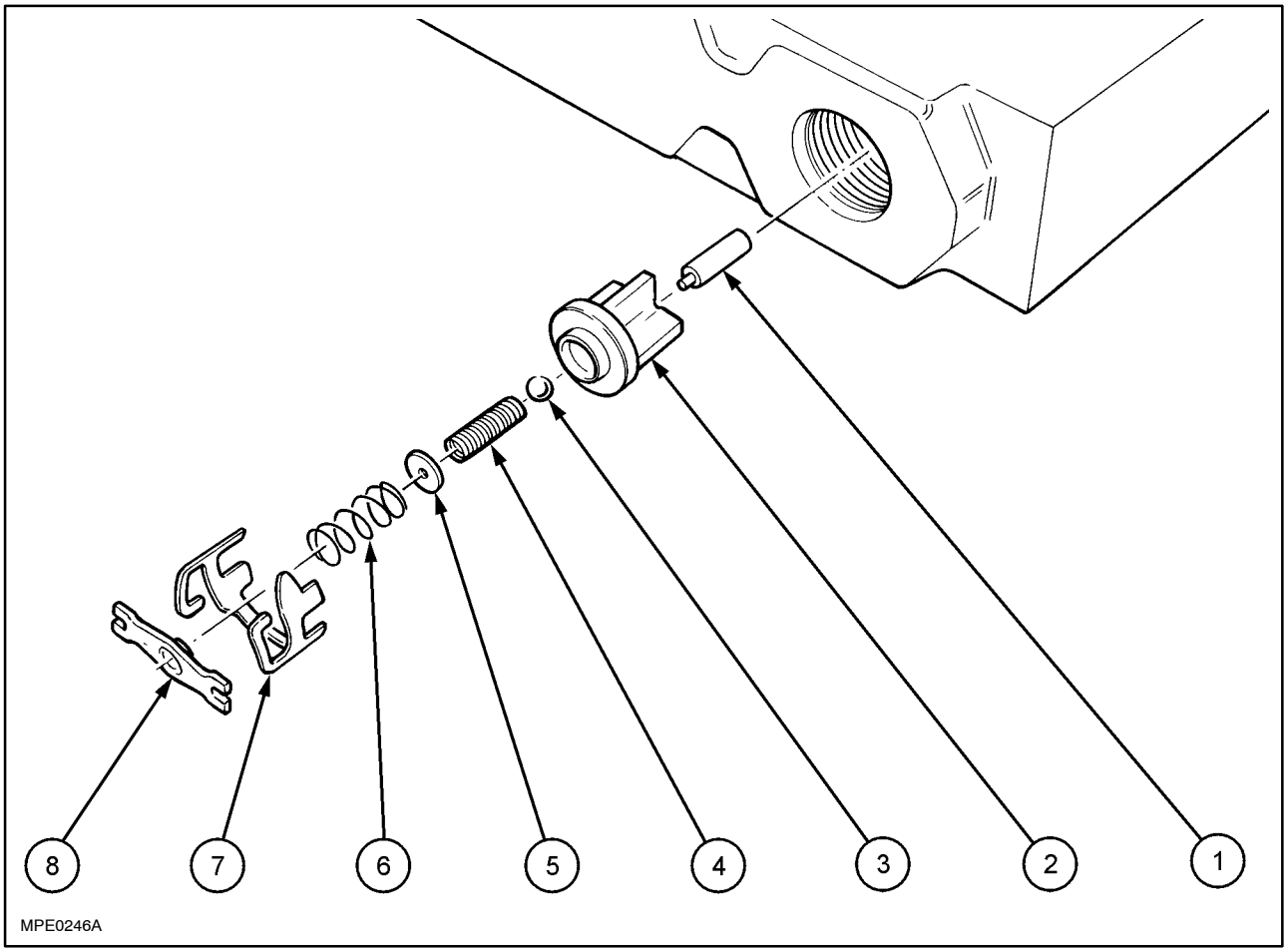
1. Flow control valve
2. Retainer
3. Spring
4. Spring guide
5. Cap and seal
6. Plastic cap
7. Retainer
8. Plug
9. Thrust ring
10. Seal
11. Spring
12. Retaining valve ball



5

Control pin

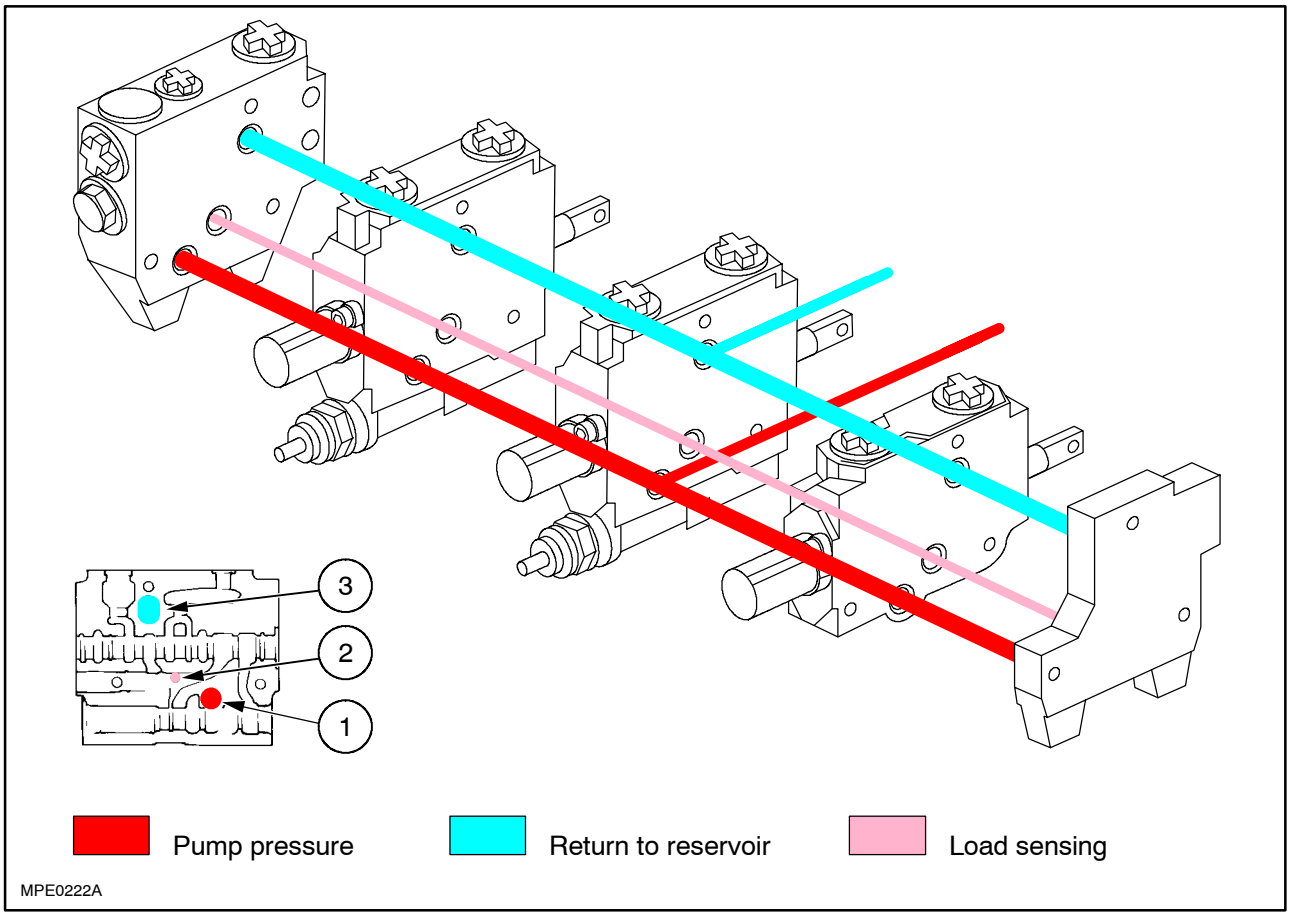
1. End plug
2. Seal
3. Spacers
4. Pin centering mechanism
5. Pin
6. Seal
7. Seal
8. Spacer
9. Thrust ring
10. Release pin
11. Ball
12. Piston
13. Spring
14. Spring cover



6

Lockout valve components

1. Piston
2. Check valve
3. Ball
4. Spring
5. Washer
6. Spring
7. Spring seat
8. Spring centering



7

Connection between auxiliary control valves

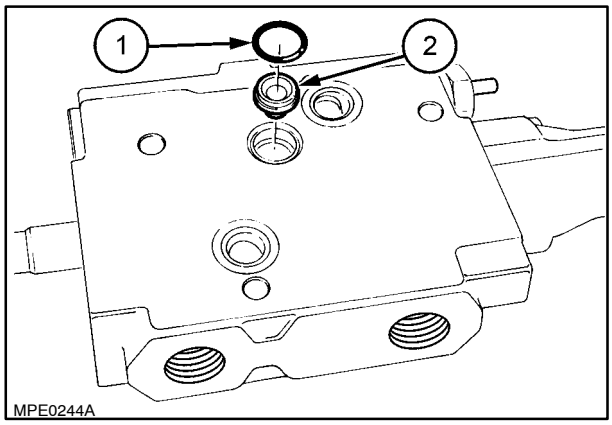
1. Parallel supply duct
2. Load sensing duct
3. Return To reservoir

All elements on the control valves use the same in-feed and return to reservoir duct, positioned in parallel.

The load sensing duct passes through the centre of the control valve unit.

The parallel ducts and load sensing system allows two or more control valves to be used simultaneously, with no loss of efficiency.

The seals (1) and the check valves on the load sensor (2), fitted between each element, ensure that the highest load sensing pressure in the circuit is directed to the hydraulic pump to control the supply.



8

LIFTING OIL FLOW (Cylinder extension)

When the control valve lever is moved onto the lifting position, the control pin (5, fig. 9) moves to the left letting the spring stop balls to couple in the grooves on the left-hand side of the automatic release mechanism (10).

By moving the pin to the lifting position, the peg (6) on the lockout valve (7) will rise on the pin and hold the valve in the open position.

Duct (B) is now connected to duct (C) and duct (E) is connected to duct (F).

The flow from duct (C) is stopped by the ball (4) on the check valve until the pressure in the duct can lift the ball in its seat, countering the pressure in duct (E) in the lifting duct.

The oil can flow:

In duct (C), through the check valve and to duct (E).

Along the flat part of the control pin and to duct (F).

Through the lock valve (7).

On the outside, through the lifting duct (8) of the auxiliary control valve.

The oil from the extended cylinder returns through the lowering duct and duct (H), around the control pin groove and flows to the reservoir through shared duct (G).

If the check valve (4) is not installed, the pump pressure may be unable to support the load in the lifting duct when the auxiliary control valve is moved from neutral to the lifting position.

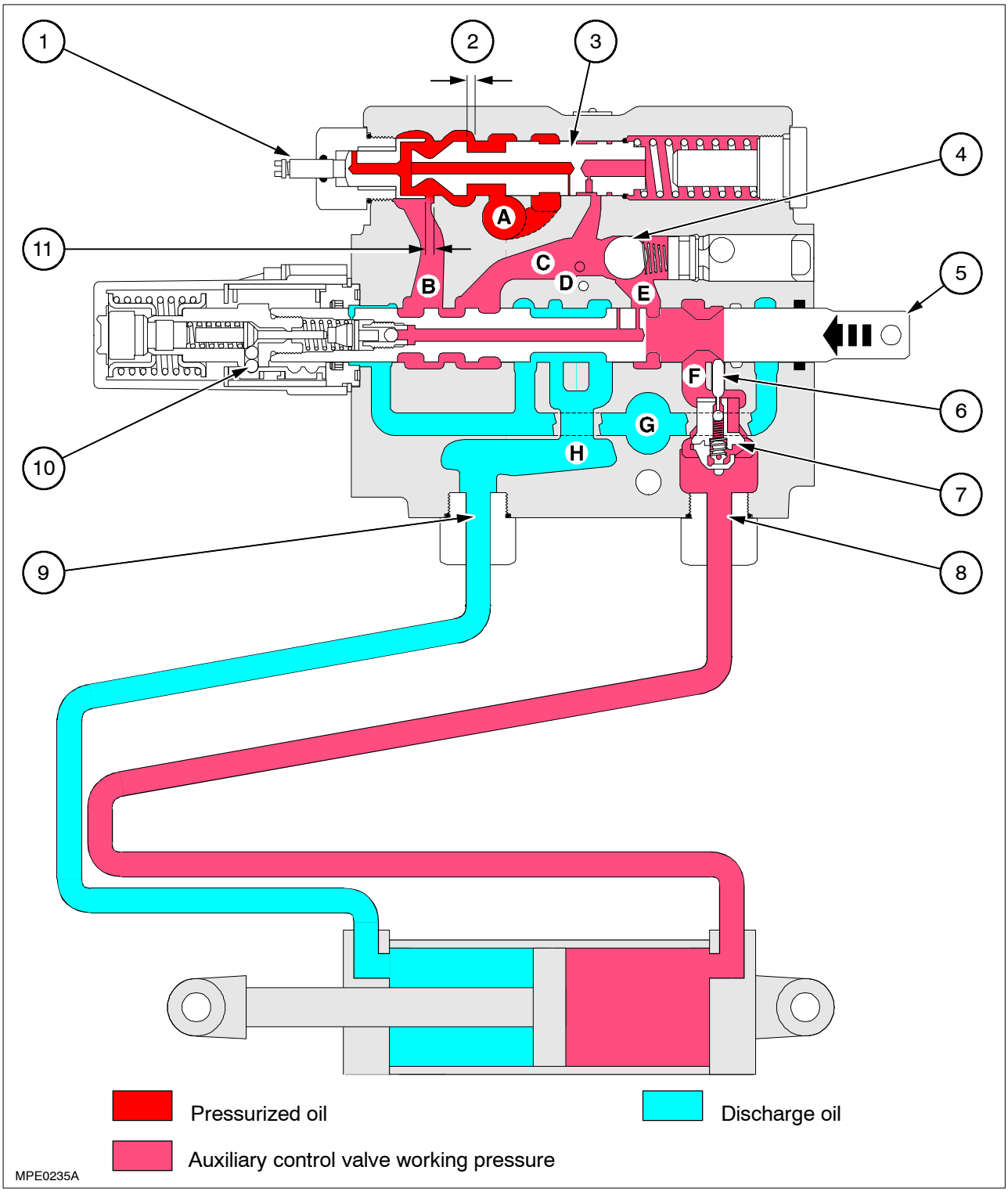
In this event, the load will momentarily lower until the pressure in the pump can sustain it.

The quantity of oil that flows through the auxiliary control valve is controlled by the flow rate manual adjustment knob (1), which manually alters the throttle clearance (11).

To maintain a constant flow rate in the auxiliary control valves when the pressure varies at the parallel duct pump infeed (A), the flow control valve reads the pressure difference at the throttle (11), manually adjusted between ducts (A) and (B).

The difference in pressure at each end of the pin makes it move to re-balance and continuously controls the flow rate on the pin grooves (2) in order to maintain a constant flow rate through the throttle (11), regardless of the pressure in the other hydraulic circuits.

The pressure in duct (C) is also directed to load sensing duct (D) and the flow rate compensating valve.



9

Auxiliary control valve operation - Lifting (cylinder extension)

1. Flow control valve adjuster
2. Groove
3. Flow control valve
4. Check valve
5. Control pin
6. Pin
7. Lockout valve
8. Lifting duct (cylinder extension)
9. Lowering duct (cylinder retraction)
10. Centering pin and release mechanism
11. Manually adjusted flow rate throttle

LOWERING OIL FLOW (cylinder retraction)

When the control valve lever is moved onto the lowering position, the control pin (5, fig. 10) moves to the right letting the spring stop balls to couple in the central groove of the automatic release mechanism (10).

As with the lifting cycle, the position of the pin allows the lockout valve (7) pin (6) to maintain the valve in the open position.

Duct (B) is now connected to duct (C) and duct (E) is connected to duct (H).

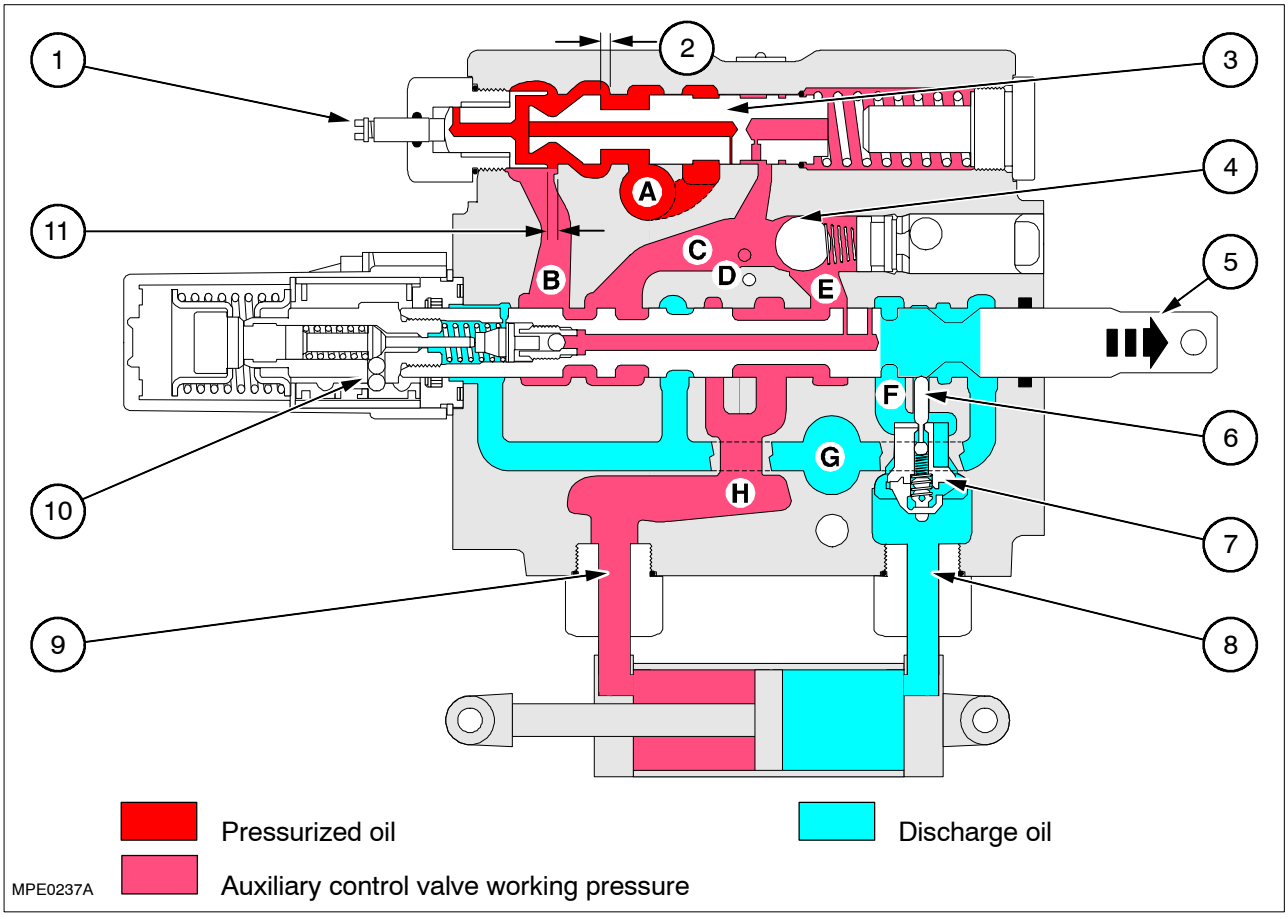
The oil from the parallel duct (A) is directed through the flow control valve and the throttle (2) and then to ducts (B), (C) and to load sensing duct (D).

The ball (4) on the check valve of the load stays closed until the pump system pressure in the duct can overcome the backpressure in duct (E).

When the ball on the check valve lifts, the oil flows to duct (E), around the control pin, to duct (H) and is directed out through the lowering duct on the auxiliary control valve.

The oil from the retracted cylinder flows to duct (G) and returns to the reservoir through the lifting duct and the lockout valve (7).

The flow rate through the auxiliary control valves is controlled in the same way in the 'Lifting oil flow' heading, i.e: reading the pressure difference inside the manually adjusted throttle (11).



Auxiliary control valve operation - Lowering (cylinder retraction) 10

1. Flow control valve adjuster
2. Groove
3. Flow control valve
4. Check valve
5. Control pin
6. Pin
7. Lockout valve
8. Lifting duct (cylinder extension)
9. Lowering duct (cylinder retraction)
10. Centering pin and release mechanism
11. Manually adjusted flow rate throttle

NEUTRAL OIL FLOW

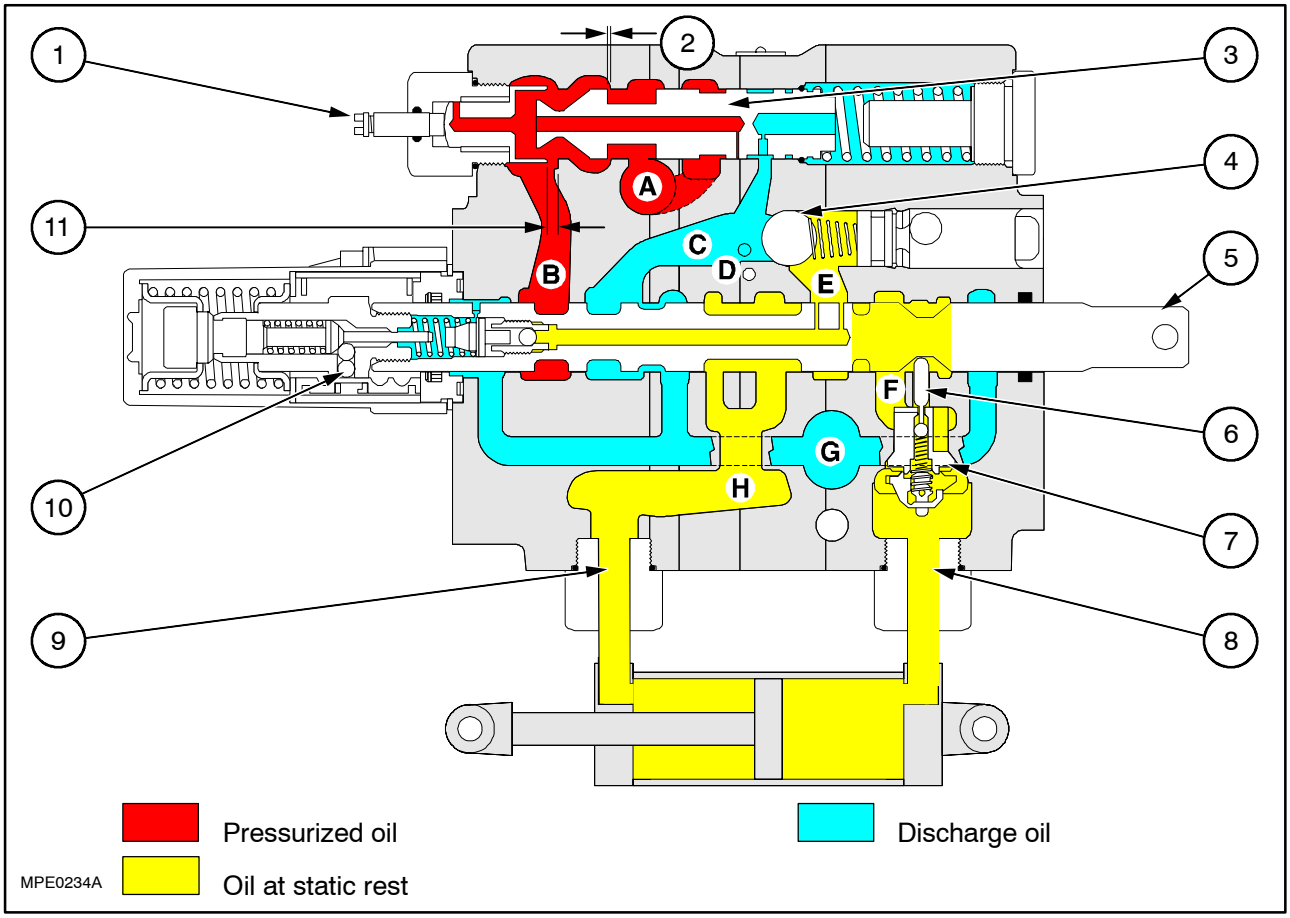
When the auxiliary control valves are in neutral, the control pin (5, fig. 11) is held in the central position by the centering spring.

The oil flow from the parallel duct (A) to the lifting and lowering ducts is stopped by the control pin grooves.

Duct (C) and load sensing duct (D) outfeed to the reservoir through duct (G).

The ducts to the lifting and lowering ducts are stopped by the control pin grooves (5).

The lockout valve pin (7) is inserted in the restriction on pin (5), keeping the valve in the closed position with the spring, to prevent an extended cylinder from retracting under load in the event of slight losses from the control pin.



Auxiliary control valve operation - Neutral 11

1. Flow control valve adjuster
2. Groove
3. Flow control valve
4. Check valve
5. Control pin
6. Pin
7. Lockout valve
8. Lifting duct (cylinder extension)
9. Lowering duct (cylinder retraction)
10. Centering pin and release mechanism
11. Manually adjusted flow rate throttle

FLOAT MODE OIL FLOW

The float mode position allows the oil to flow from both the lifting duct and the lowering duct on the auxiliary control valve, permitting the cylinders to extend or retract freely.

This is particularly useful for implements such as leveller blades, allowing them to “float” whilst following the profile of the ground surface.

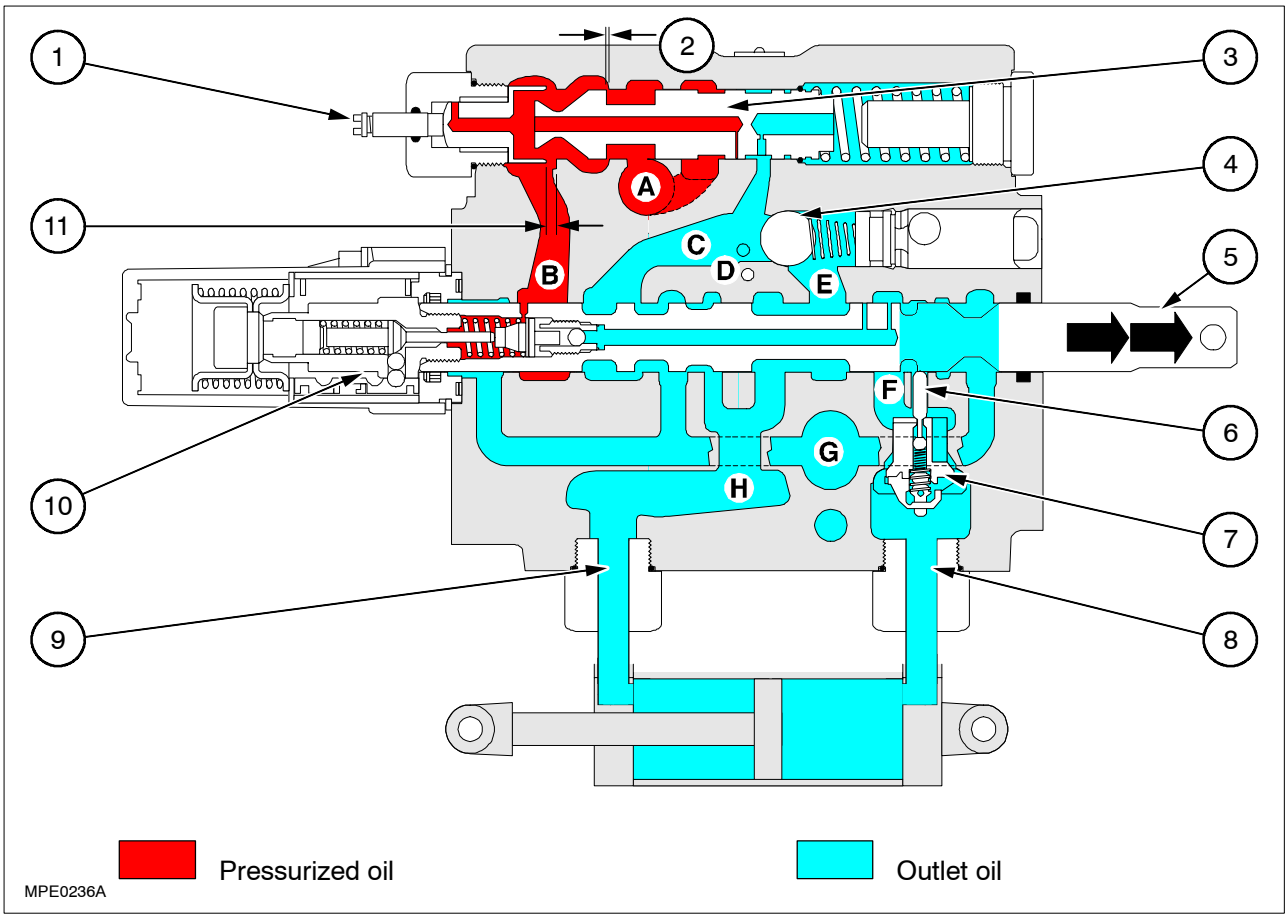
When the control valve lever is moved fully forward onto the floating mode position, the control pin (5, fig. 12) moves completely to the right letting the spring stop balls (10) couple in the groove on the right-hand side of the automatic release mechanism.

The oil flow from duct (B) to the lifting and lowering ducts is stopped by the pin grooves.

As a result of the position of the pin, the lockout valve (7) pin (6) keeps the valve in the open position.

The auxiliary control valve lifting and lowering ducts are connected to duct (G) on the reservoir, allowing the oil to flow freely from one duct on the cylinder to the other.

If there is a vacuum in the circuit, the oil is sucked from one end of the cylinder to the other.



Auxiliary control valve operation - Float mode 12

1. Flow control valve adjuster
2. Groove
3. Flow control valve
4. Check valve
5. Control pin
6. Pin
7. Lockout valve
8. Lifting duct (cylinder extension)
9. Lowering duct (cylinder retraction)
10. Centering pin and locking mechanism
11. Manually adjusted flow rate throttle

AUTOMATIC RELEASE PRESSURE REGULATING VALVE OPERATION

Under normal working conditions, the auxiliary circuits are protected from excess pressure by the release pressure control valve, which moves the control pin to neutral when the working pressure of the cylinder exceeds the pre-set value.

If the auxiliary control valve lever is kept stationary by the operator to prevent the pin (3, fig. 13) gong back to neutral, the maximum working pressure is limited to a maximum of 2828.38 psi (195 bar) by the pressure compensating valve in the hydraulic pump.

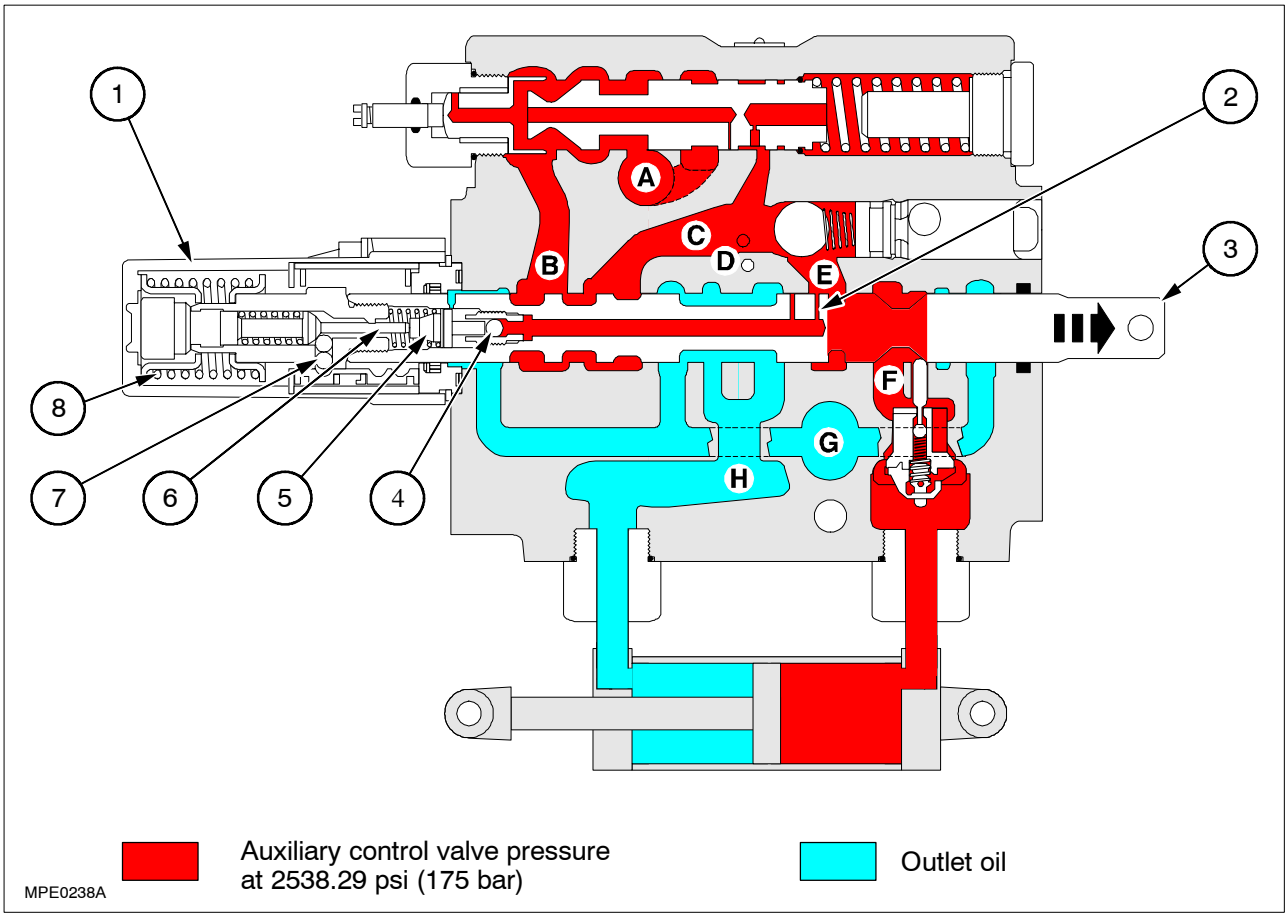
The operation of the release adjustment valve is as follows:

When the control valve pin is moved to the lifting or lowering position, the centering pin and automatic release mechanism retaining balls (1) are locked by the conical part of the spring piston.

When lifting or lowering, the working pressure of the auxiliary control valve circuit is also detected in the central hole of the pin through the small radial orifices (2).

As the pressure increases, the force applied on the smallest ball (4) on the end of the pin (3) pushes the automatic release control valve piston (5) and the spring piston (6) to the left.

When the automatic release pressure 2538.29 psi (175 bar) is reached, the centering mechanism balls are no longer held by the conical part of the pre-loaded piston, and the centering spring (8) moves the pin to neutral.



Automatic release pressure regulating valve operation 13

1. Centering pin and automatic release mechanism
2. Radial ducts
3. Control pin
4. Ball
5. Stop piston
6. Pre-loaded spring piston
7. Stop balls
8. Centering spring

OPERATION OF TWO OR MORE AUXILIARY CONTROL VALVES SIMULTANEOUSLY

As the auxiliary control valves are provided with a shared parallel inlet duct and individual flow rate control valves, two or more auxiliary control valves can operate at the same time, with no loss of efficiency.

This is carried out by the flow rate adjusters, which regulate the flow through each auxiliary control valve, regardless of the pump pressure.

If theses valves were not fitted and two auxiliary control valves worked at the same time at different pressures, the oil would tend to flow to the circuit with the lighter load.

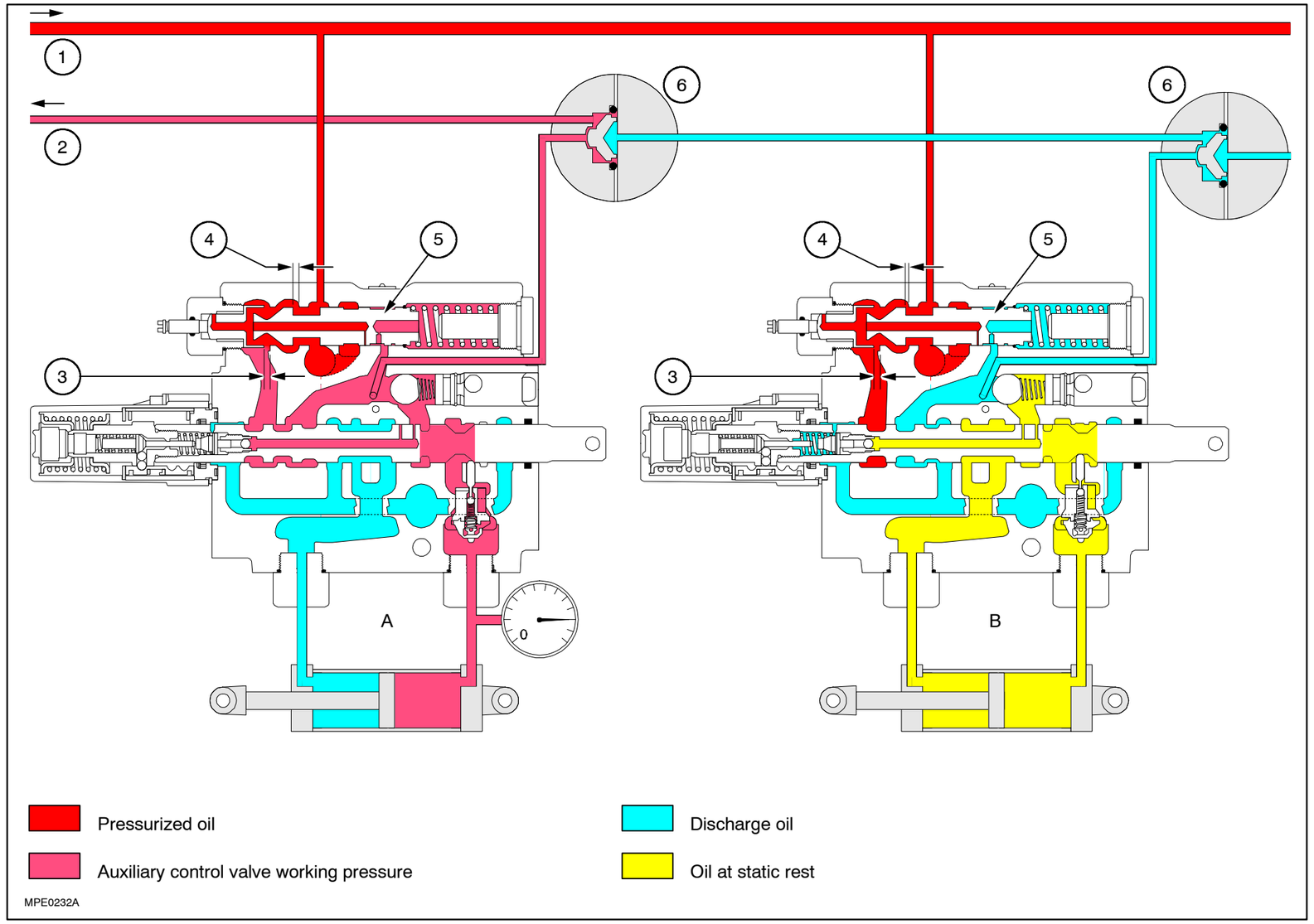
There follows a detailed explanation of single auxiliary control valve operation and combined operation with another auxiliary control valve.

When only one auxiliary control valve is used, the pressure in the parallel duct is the same as the pump pressure.

The auxiliary control valve flow rate is set by the flow rate adjusting knob, controlling the limiter clearance (3).

The limiter pressure differential (3) is taken at each end of the flow rate control pin (5), which moves to a balanced position to dose the flow rate on the grooves (4).

Control of the flow rate on the grooves (4) produces a constant flow rate through the flow rate manual limiter (3) and through the auxiliary control valve.



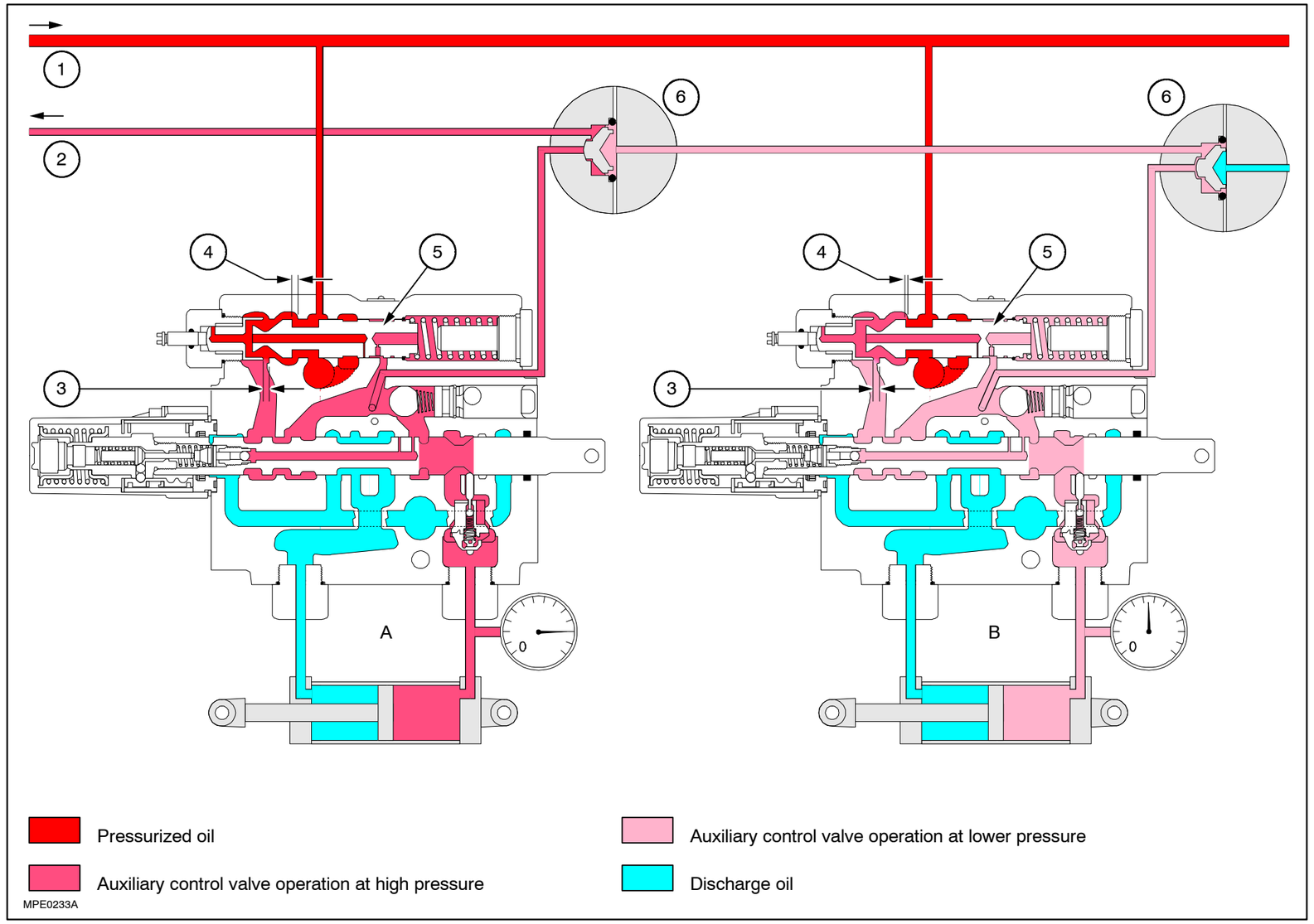
Operation with a single auxiliary control valve 14

A. Auxiliary control valve operating
B. Auxiliary control valves in neutral

1. Parallel duct (connecting the auxiliary control valve elements)
2. Load sensing line (connecting the auxiliary control valve elements)
3. Manual flow rate limiter
4. Grooves
5. Flow control valve
6. Load sensing line check valve

It is essential that oil flow is controlled singularly through two or more auxiliary control valves, working simultaneously at different pressures, otherwise the oil will tend to flow towards the circuit with lower pressure.

When using two or more hydraulic services, the working pressure in the parallel duct is at the maximum value of the hydraulic system, as read through load sensing line.



Operation with two auxiliary control valves 15

A. Auxiliary control valve operating at high pressure

1. Parallel duct (connecting the auxiliary control valve elements)
2. Load sensing line (connecting the auxiliary control valve elements)
3. Manual flow rate limiter

B. Auxiliary control valve operating at low pressure

4. Grooves
5. Flow control valve
6. Load sensing line check valve

Op. 35 204 40
AUXILIARY CONTROL VALVES R.I.

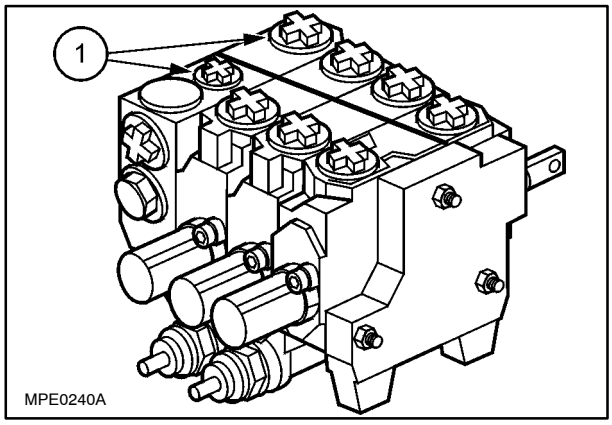
DANGER

Lift and handle all heavy parts using suitable lifting equipment.

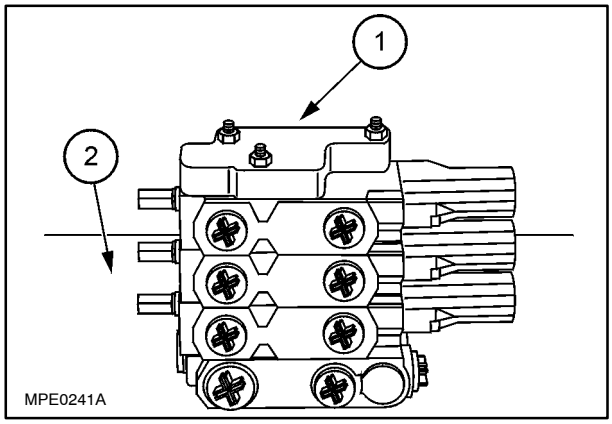
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

Proceed as follows:

1. Clean the auxiliary control valve unit before removing.
2. Lower the hydraulic arms.
3. Disconnect the auxiliary control valve tie-rods.
4. Disconnect the auxiliary control valve hydraulic piping.
5. To facilitate assembly operations, mark a diagonal line on the control valve unit.
   Close the hydraulic ducts with plastic caps (1) to prevent foreign matter from entering.
6. Using a suitable hoist, support the auxiliary control valves unit, unscrew the retaining bolts and extract the unit from the tractor.
7. Position and secure the control valves unit (1) on the workbench (2).

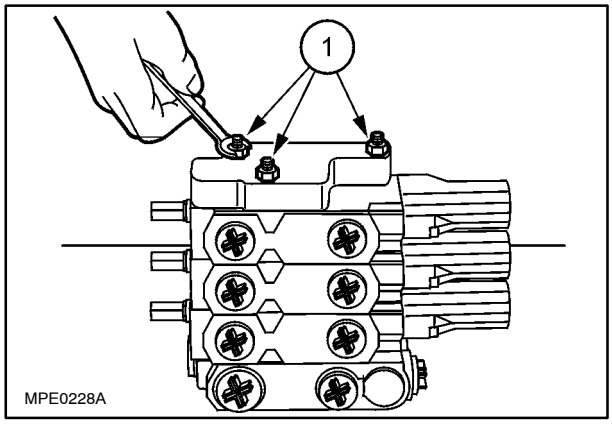


16



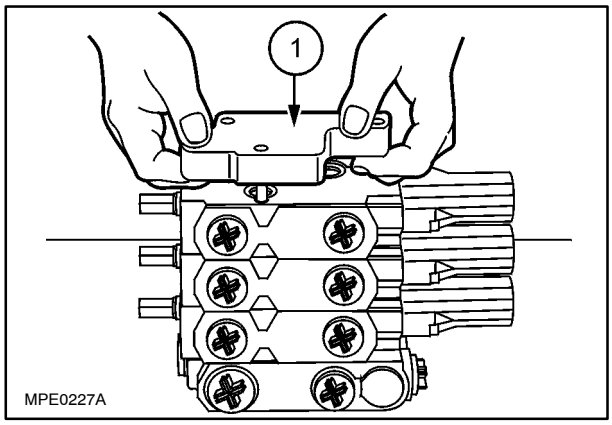
17

8. Unscrew the retaining nuts (1) on the control valve elements.



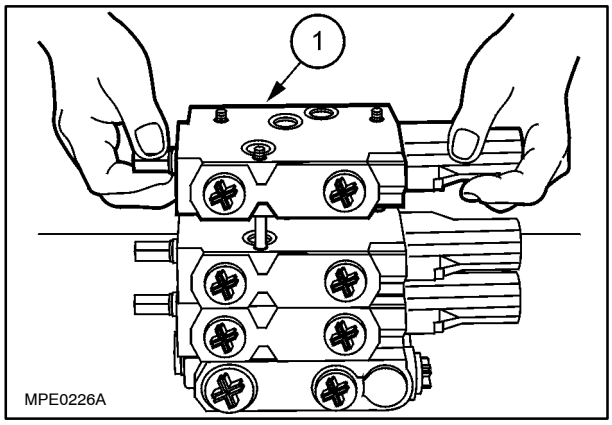
18

9. Remove the end plate (1).



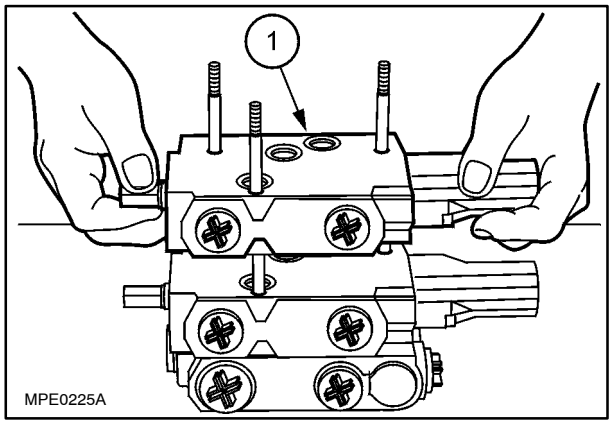
19

10. Extract the first auxiliary control valve (1).



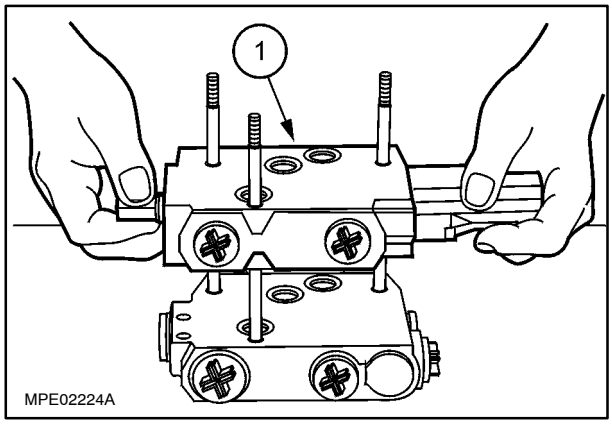
20

11. Extract the second auxiliary control valve (1).



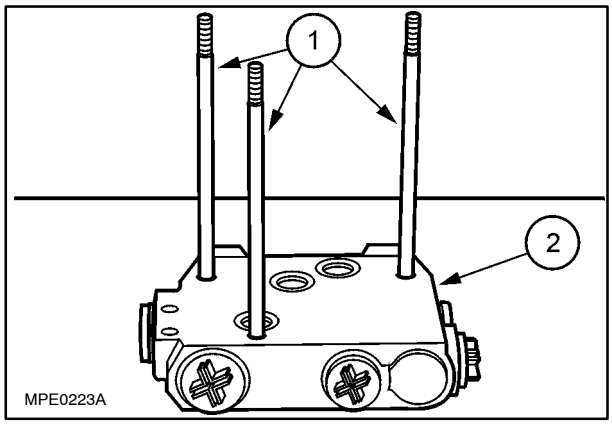
21

12. Extract the third auxiliary control valve (1).



22

13. If necessary, remove the threaded tie-rods (1) on the connecting plate (2).



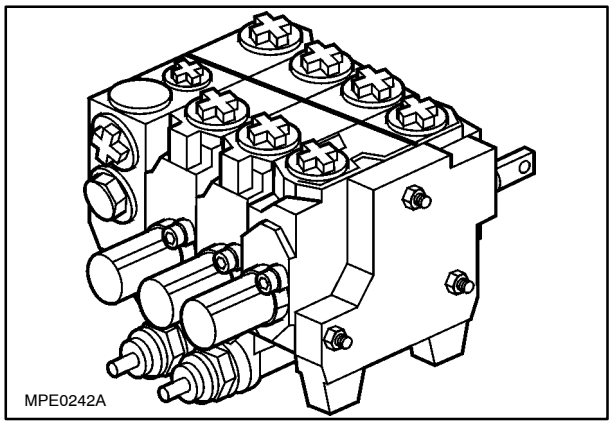
23

14. To refit the auxiliary control valves, proceed as follows.

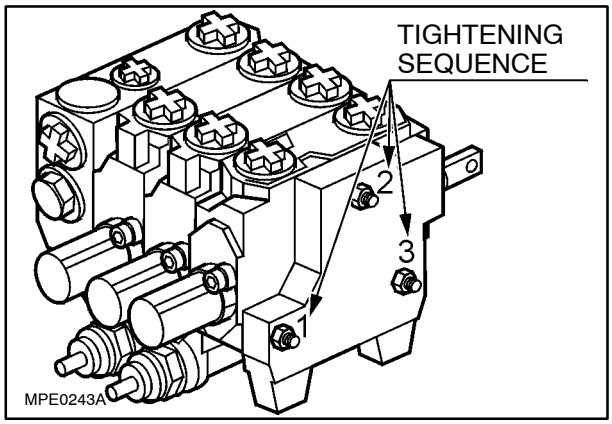
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- For the positioning of the various parts refer to figure 2 and the previously illustrated figures.
- Before reassembling, clean and degrease the mating surfaces.
- Respect the tightening torques prescribed on page 3.
- Tighten the threaded tie-rods on the connecting plate (1, fig. 2).
- Make sure that the seal (1, fig. 8) and check valve (2) are correctly seated.
- Fit the control valves in the order indicated in figure 2 according to the diagonal line marked before disassembly.
- Position the end plate.
- Tighten the retaining nuts to 30 to 33 Nm in sequence 1, 2, 3.



24



25

- Position and secure the auxiliary control valves in the seat.
- Connect the hydraulic piping.
- Connect the tie rods.

Op. 35 204 46
AUXILIARY CONTROL VALVES D.A.
with the unit removed

CAUTION

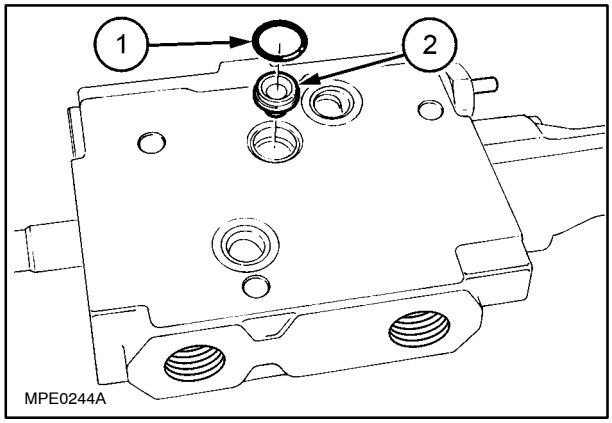
Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

Disassemble the control valve, referring to the following figures:

1. Remove the seal (1) and the load sensing check valve (2).

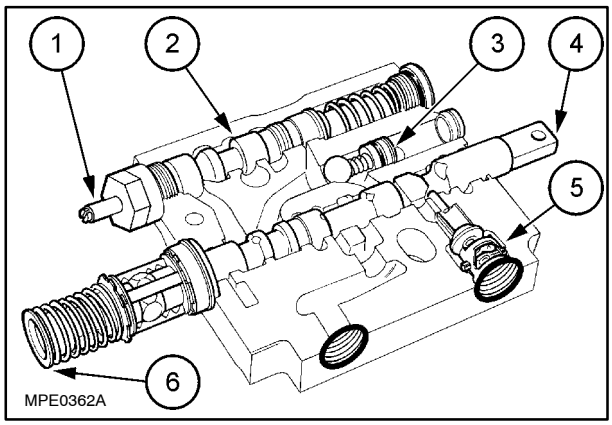


26

2. Remove the threaded parts on the ends and extract the flow adjuster (2) from the valve body.

Auxiliary control valve components

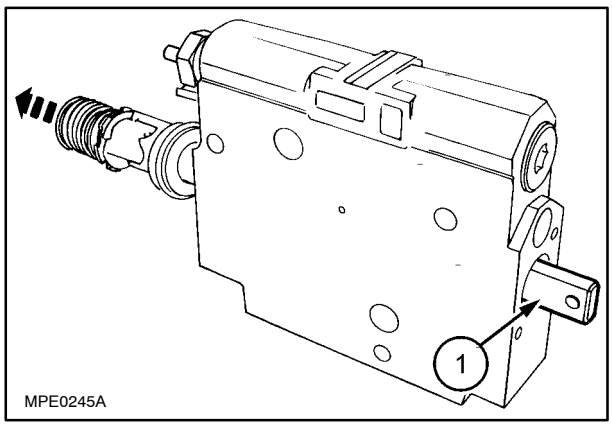
1. Flow control valve adjustment
2. Flow control valve
3. Check valve
4. Control pin
5. Lockout valve
6. Pin centering mechanism



27

3. Remove the control pin (1).

NOTE: *Before removing the pin, make sure that its flat sides (1) are upright at the end, as shown. If necessary, rotate the pin but do not use force as this may damage the pin and the lock valve pin (5).*



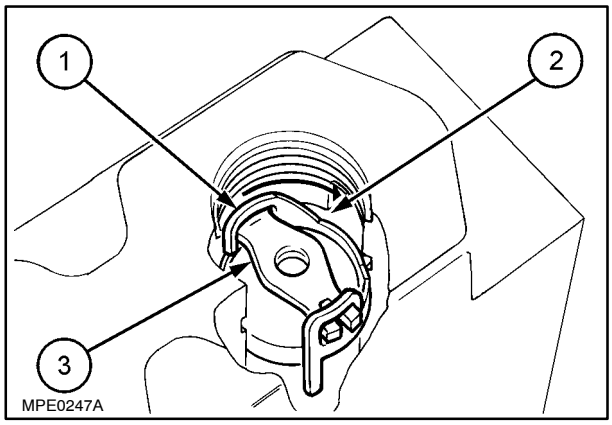
28

4. Remove the lock valve from the lifting duct as follows:

   Using a small screwdriver, open the two slots (1) on the retaining device (2) and rotate through 90 degrees.

   Remove the spring seat (3) from the housing.

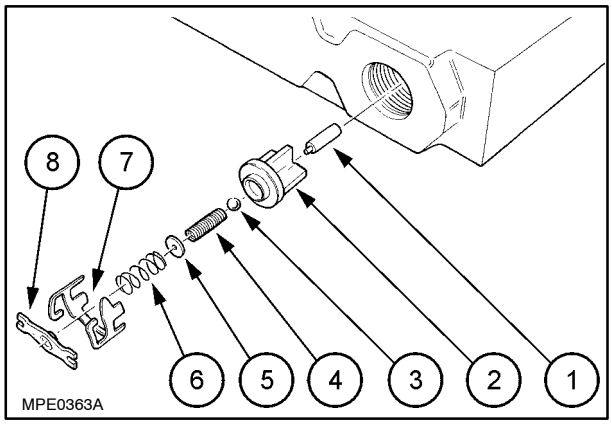
   Remove the lock valve and piston.



29

5. Remove in succession:

   retaining device (8), spring seat (7), spring (6), washer (5), spring (4), ball (3), lock valve (2) and piston (1).

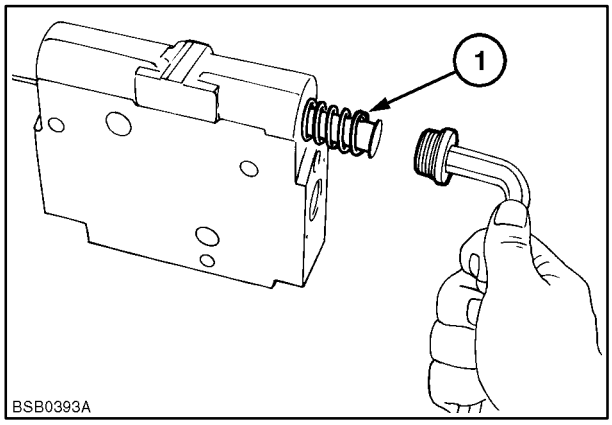


30

6. Carefully remove the flow control plug.

CAUTION

Take care when removing the plug as it is under the pressure of spring (1).

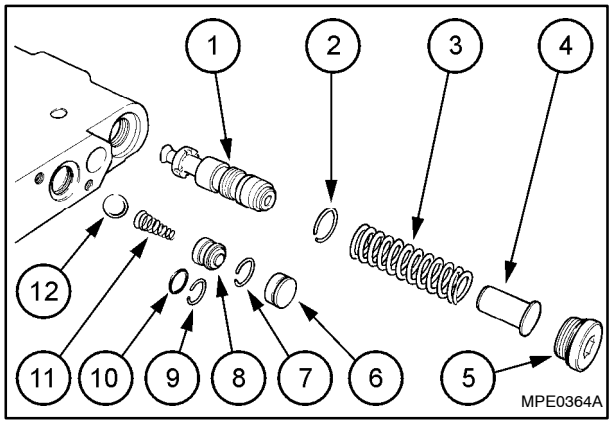


31

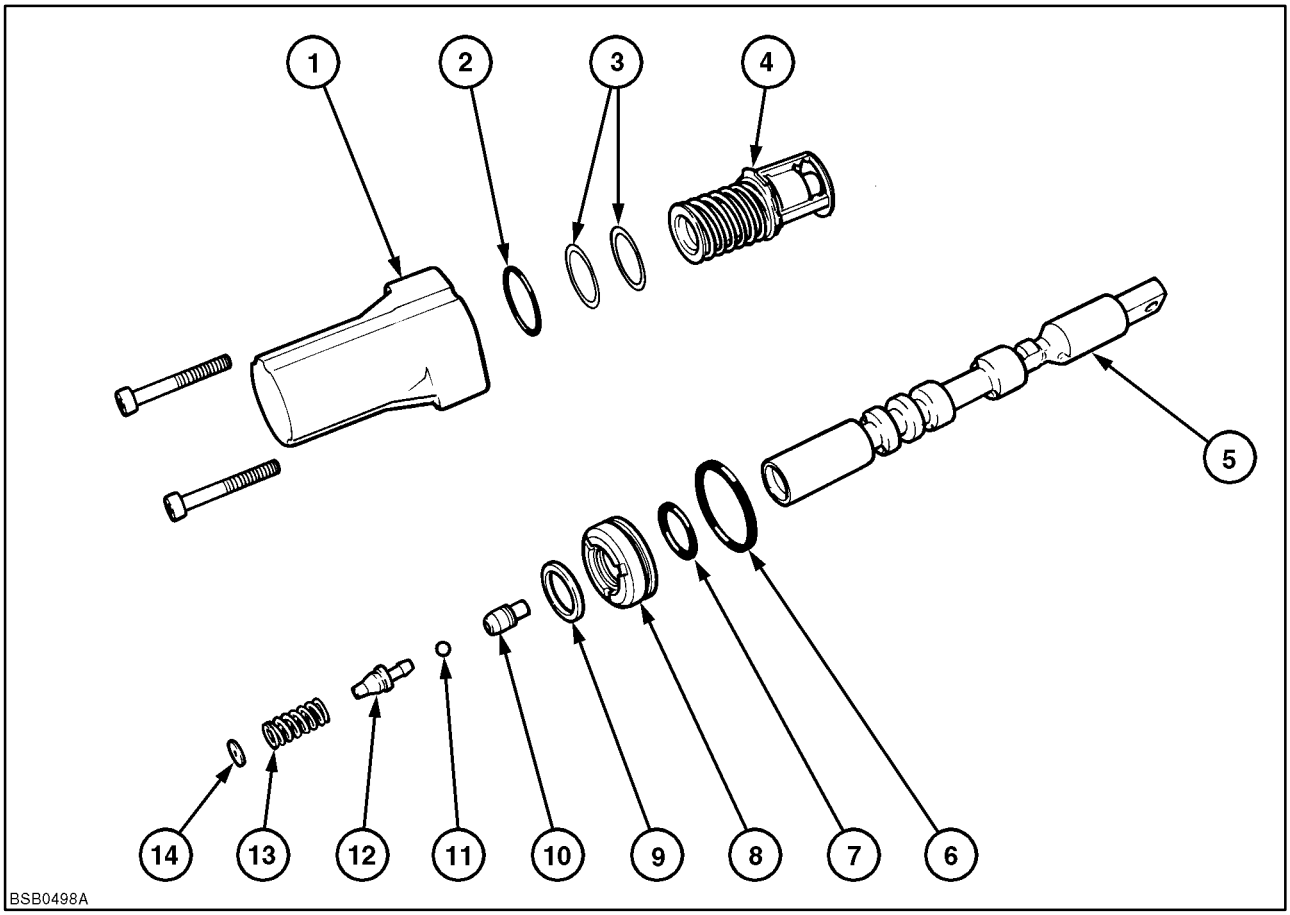
7. Remove in succession:

   plug (5) with seal, spring guide (4), spring (3), retainer (2) and flow control valve (1).

8. Then disassemble the lock valve removing the guard (6), retainer (7), plug (8), ring (9), gasket (10), spring (11) and ball (12).



32



33

Control pin

1. End plug
2. Seal
3. Spacers
4. Pin centering mechanism
5. Pin
6. Seal
7. Seal
8. Spacer
9. Thrust ring
10. Release clearance
11. Ball
12. Piston
13. Spring
14. Spring seat

9. Remove the control pin by unscrewing the centering mechanism.

   Do not disassemble the mechanism.

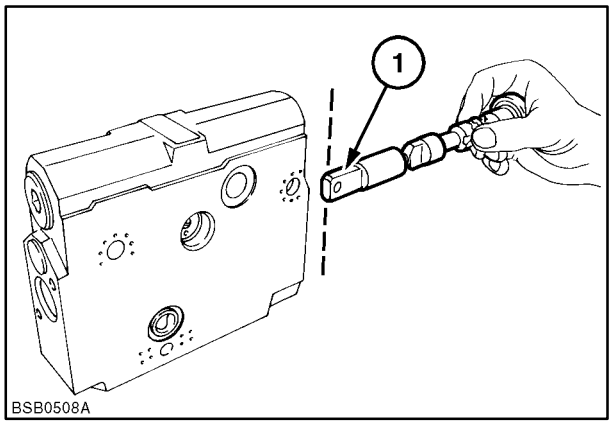
10. The release clearance is at the centre of the pin. It is a pre-set mechanism which only requires washing with a degreasing product, without removing the pin clearance.

Assembly

1. For assembly operations, follow the disassembly operations in reverse order.

   Remember to fit the lock valve before the control pin.

2. Before inserting the control pin in its seat, make sure that the flat sides (1) at the end of the pin are in an upright position, as in the figure. **DO NOT rotate the pin once inserted in the seat**, this would damage the pin and the lock valve piston.

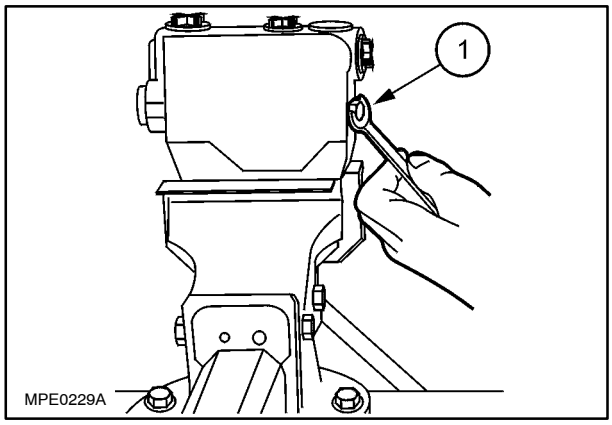


34

CONNECTING PLATE

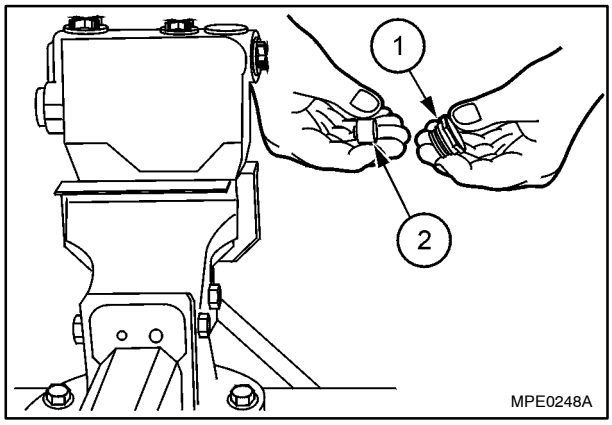
Disassembly

1. Unscrew the closing cap (1).



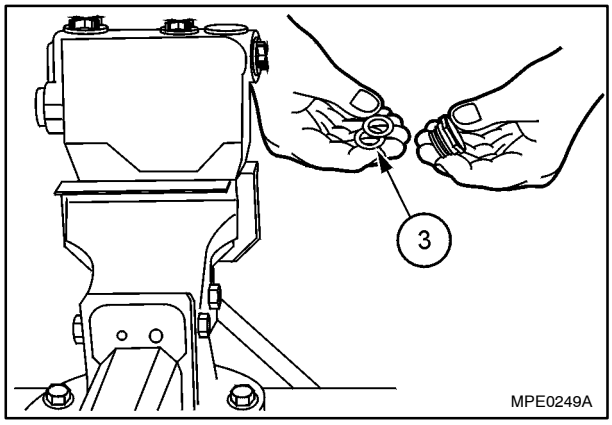
35

2. Remove the cap (1) and the plunger (2).



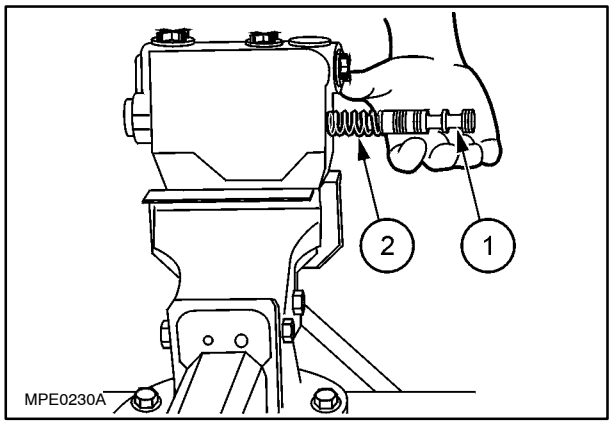
36

3. Remove the adjustment shims (3).



37

4. Extract the pin (1) and spring (2).



38

Assembly

1. For assembly operations, follow the previously described disassembly operations in reverse order.

SECTION 35 - HYDRAULIC SYSTEMS

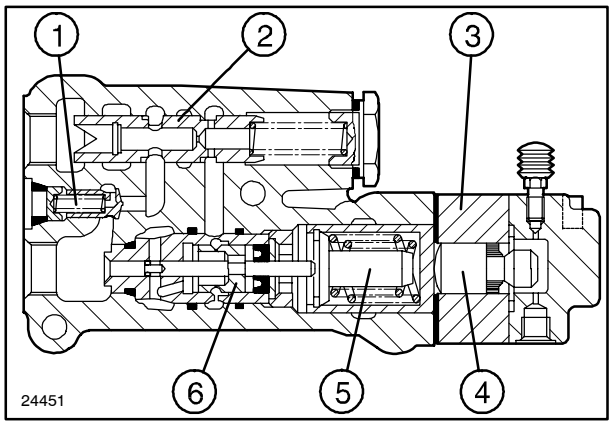
Chapter 4 - Trailer brake auxiliary control valves

CONTENTS

Operation	Description	Page
	Cross-sectional views	1
	Description and Operation	1
	Trailer brake control valve hydraulic circuit diagram with KONTAK control valves	2
	Trailer brakes control valve hydraulic circuit diagram with BOSCH control valves	3
	Functional testing and troubleshooting	10

Cross-sectional view of auxiliary control valve for trailer brakes. (Open-centre circuit)

1. Non-return valve.
2. Flow control valve.
3. Pilot valve casing.
4. Pilot valve piston.
5. Pressure limiter.
6. Slide piston.



1

DESCRIPTION AND OPERATION

The trailer brake valve is located on the right-hand side of the rear transmission casing, controlled by the lift control pump and has priority over both the auxiliary control valves and the hydraulic lift.

The trailer brake valves mounted in the outfit with Kontak auxiliary control valves or in the outfit with Bosch auxiliary control valves are the same.

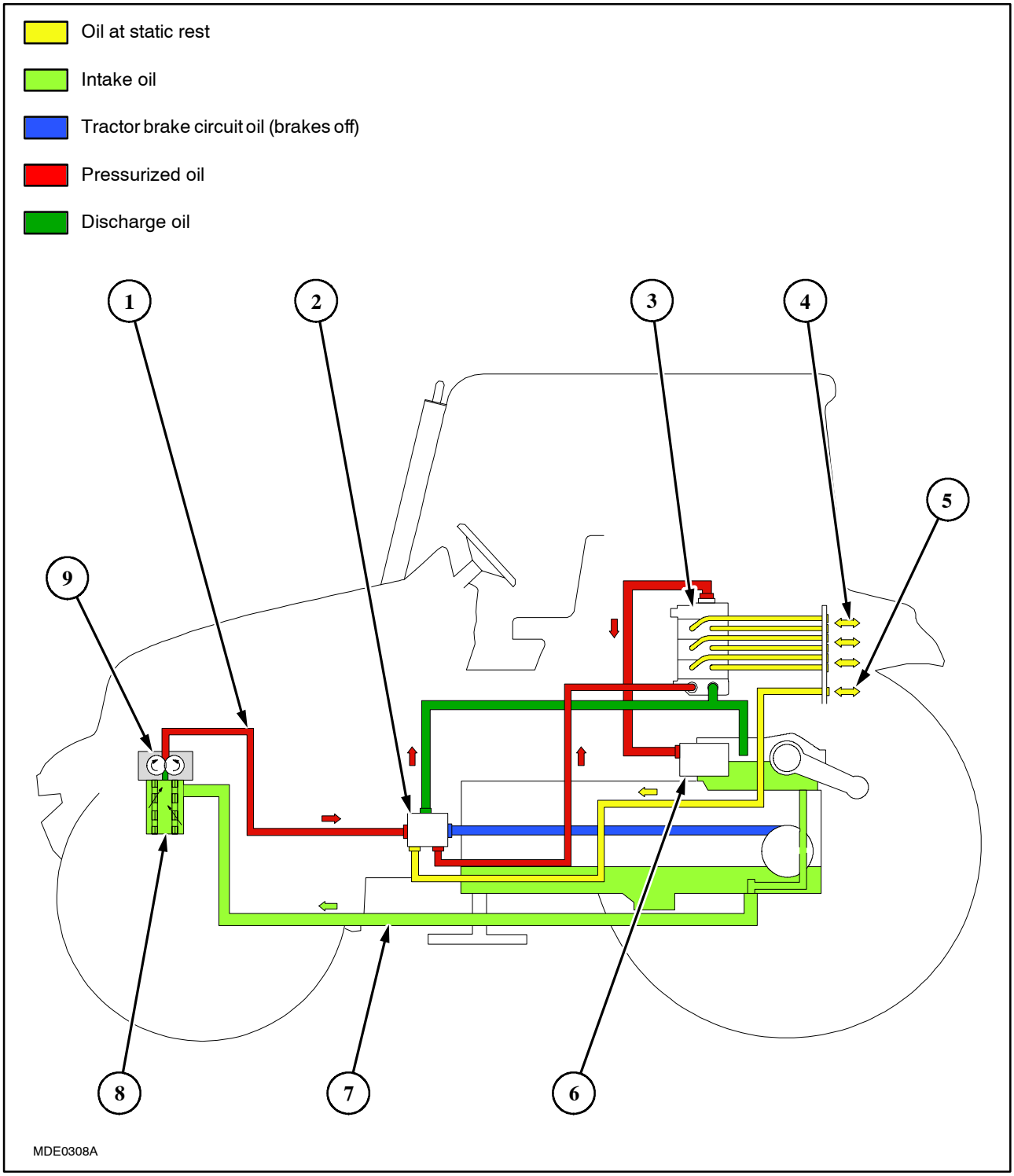
For the hydraulic operation of the trailer brake valve, see pages 4 and 5.

The ITALIA trailer brake valve provides the advantage and safety of having the trailer brakes applied even with:

- engine off;
- pump faulty (or with low delivery).

A description of the ITALIA trailer brake valve can be found on pages 6 to 9.

TRAILER BRAKE AUXILIARY CONTROL VALVE

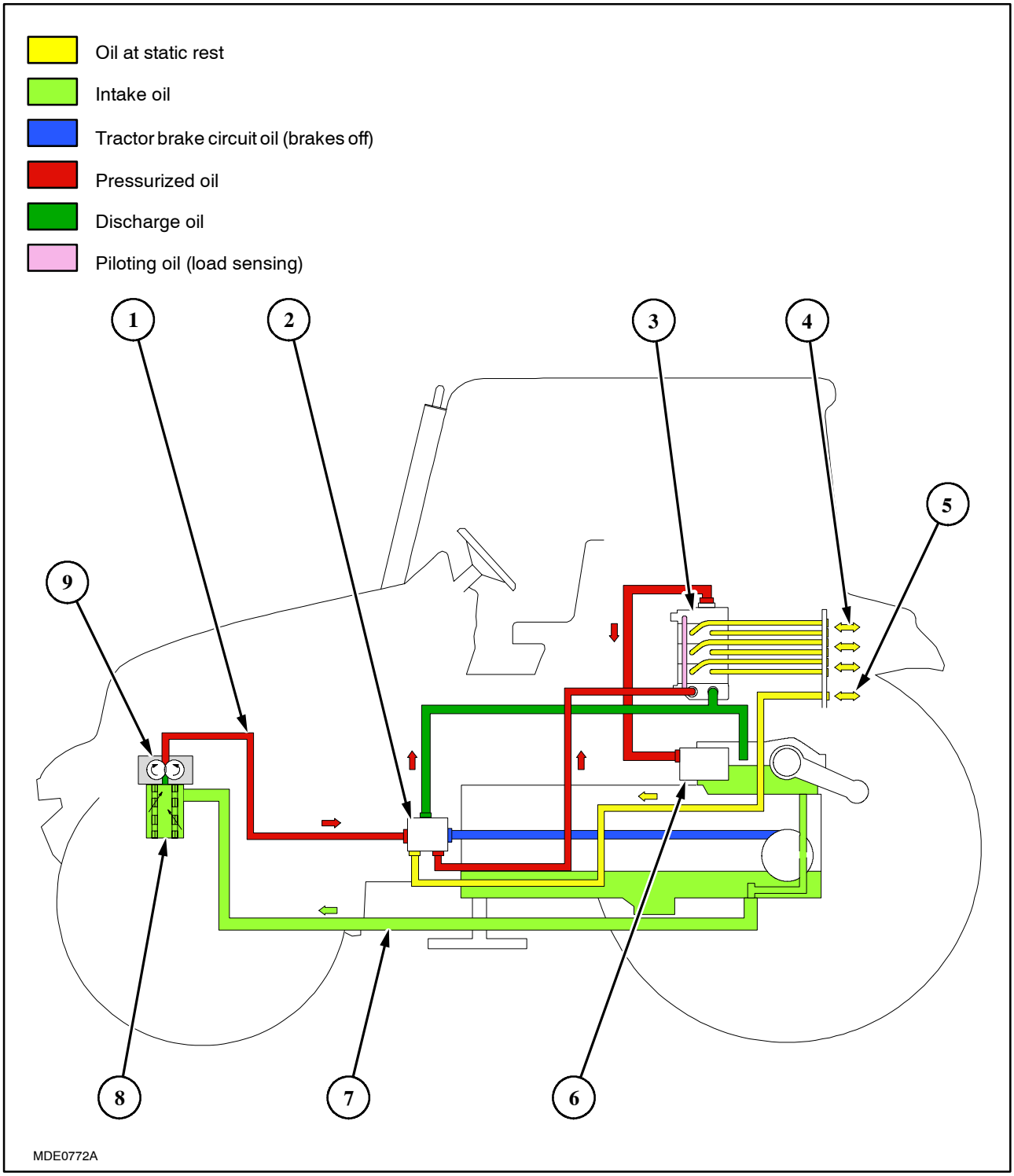


2

Diagram of the trailer brake auxiliary control valve hydraulic circuit (with KONTAK auxiliary control valves)

1. Delivery line to control valve (3).
2. Trailer brake auxiliary control valve.
3. Auxiliary control valves.
4. Auxiliary control valve lines.
5. Trailer brake control valve line.
6. Lift control valve.
7. Intake line.
8. Oil filter.
9. Hydraulic pump.

TRAILER BRAKE AUXILIARY CONTROL VALVE



3

Diagram of the trailer brake auxiliary control valve hydraulic circuit (with BOSCH auxiliary control valves)

1. Delivery line to control valve (3).
2. Trailer brake auxiliary control valve.
3. Auxiliary control valves (with UNLOAD valve).
4. Auxiliary control valve lines.
5. Trailer brake control valve line.
6. Lift control valve.
7. Intake line.
8. Oil filter.
9. Hydraulic pump.

TRAILER BRAKES OFF

With the trailer brakes off, the oil from the hydrostatic circuit connected to the control valve by union (Y) is not pressurised and therefore the piston (5) of the pilot valve (6) and the slide piston (7) are in the rest positions indicated in fig. 4.

The oil from the hydraulic pump (9, figs. 2 - 3) flows to port (P_1, fig. 4) and passes through the diaphragm (1) and constriction (3) where there is a drop in pressure, pushing the flow control valve (2) to the right.

The majority of the oil flows through the port (N) to the auxiliary control valves, while the rest of the oil is discharged to the hydraulic lift through the line (4), slide piston (7) and port (R).

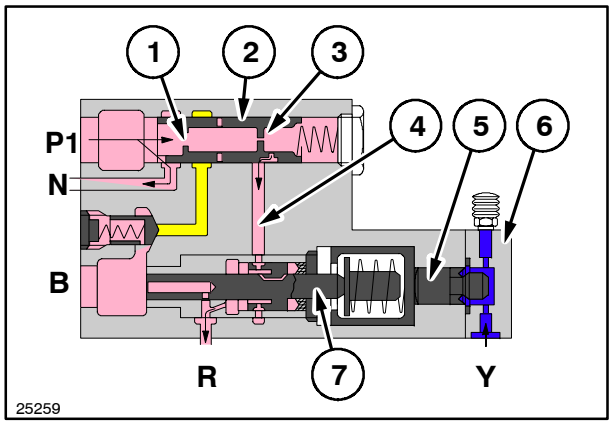
Pressurized oil

Oil in suction, delivery or return

Oil at static rest

Tractor brake circuit oil (brakes off)

Pressurised tractor brake circuit oil



4

Trailer brakes off

N. To the auxiliary control valves.

P_1. From the hydraulic pump to the lift circuit.

R. To the lift return line.

Y. From the tractor brakes.

START OF BRAKING

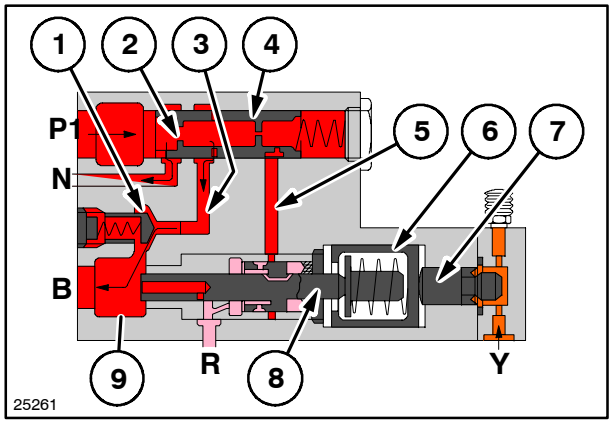
When the tractor brake pedals are pressed, the fluid in the hydrostatic circuit enters the port (y) under pressure and moves the piston (7, fig. 5), pressure limiter (6) and slide piston (8) to the left.

This interrupts the communication with the oil discharge union (R), trailer brake union (B) and line (5).

The oil inside the flow control valve (4) is maintained at a uniform pressure, allowing the valve element, under the action of the spring, shifts to the left to assume the position indicated in the drawing.

Part of the oil from the hydraulic pump in port (P_1), flows to the auxiliary control valves through port (N), while the remaining part arrives at the tractor braking element via the diaphragm (2), line (3), check valve (1) and port (B).

As the pressure of the oil in the trailer brake port (B) increases, it acts on the active surface (9) of the slide piston (8), opposing the pressure applied on piston (7) by the oil in the hydrostatic tractor brake circuit.



5

Start of braking

B. To the trailer brake.

N. To the auxiliary control valves.

P_1. From the hydraulic pump to the lift circuit.

R. To the return line in the lift.

Y. From the tractor brakes.

BRAKING

If the driver continues to operate the tractor brake pedals, the pressure of the oil in the trailer brake port (B) increases and acts on the active surface (10) of the side piston (9), and overcomes the resistance of the pressure limiter (8) springs (7), to shift the slide piston (9) to the right.

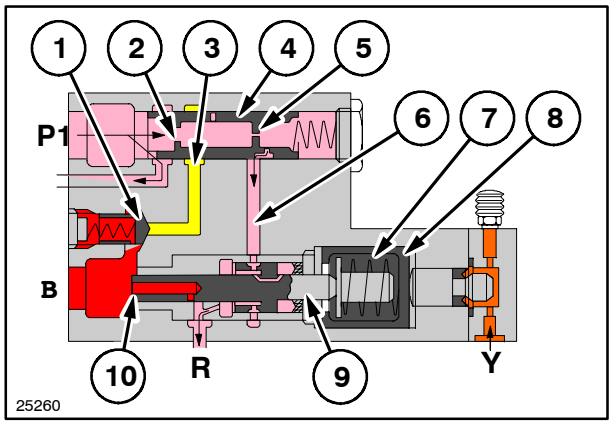
When the pressure in the trailer brake circuit balances the pressure exerted by the springs (7), the slide piston (9) stabilises in the position indicated in fig. 6 opening the passage connecting the oil from the pump with the hydraulic lift return line through port (P_1), the diaphragm (2), constriction (5), line (6) and port (R).

The diaphragm (2) and the constriction (5) cause a drop in the pressure of the oil circulating in the flow control valve (4), thus shifting the valve element to the right to close passage (3) and consequently the check valve (1).

Further pressure on the tractor brake pedals shifts the piston (7, fig. 5), the pressure limiter (8, fig. 6) and the slide piston (9) to the left, thus causing an increase in the trailer brake circuit pressure, repeating the stages described in the paragraph **START OF BRAKING**.

If the pressure in the trailer brake circuit increases as a result of external causes, the slide piston (9) shifts rapidly to open the passage connecting the trailer brake port (B) and the lift return port (R), thus maintaining a perfect balance between the oil pressure in the braking circuit and the force exerted by the pressure limiter springs (7).

On releasing the tractor brake pedals, the pressure in port (y) drops and the conditions illustrated in fig. 4 are restored.



6

Braking

B. To the trailer brake.

P_1. From the hydraulic pump to the lift circuit.

R. To the return line in the lift.

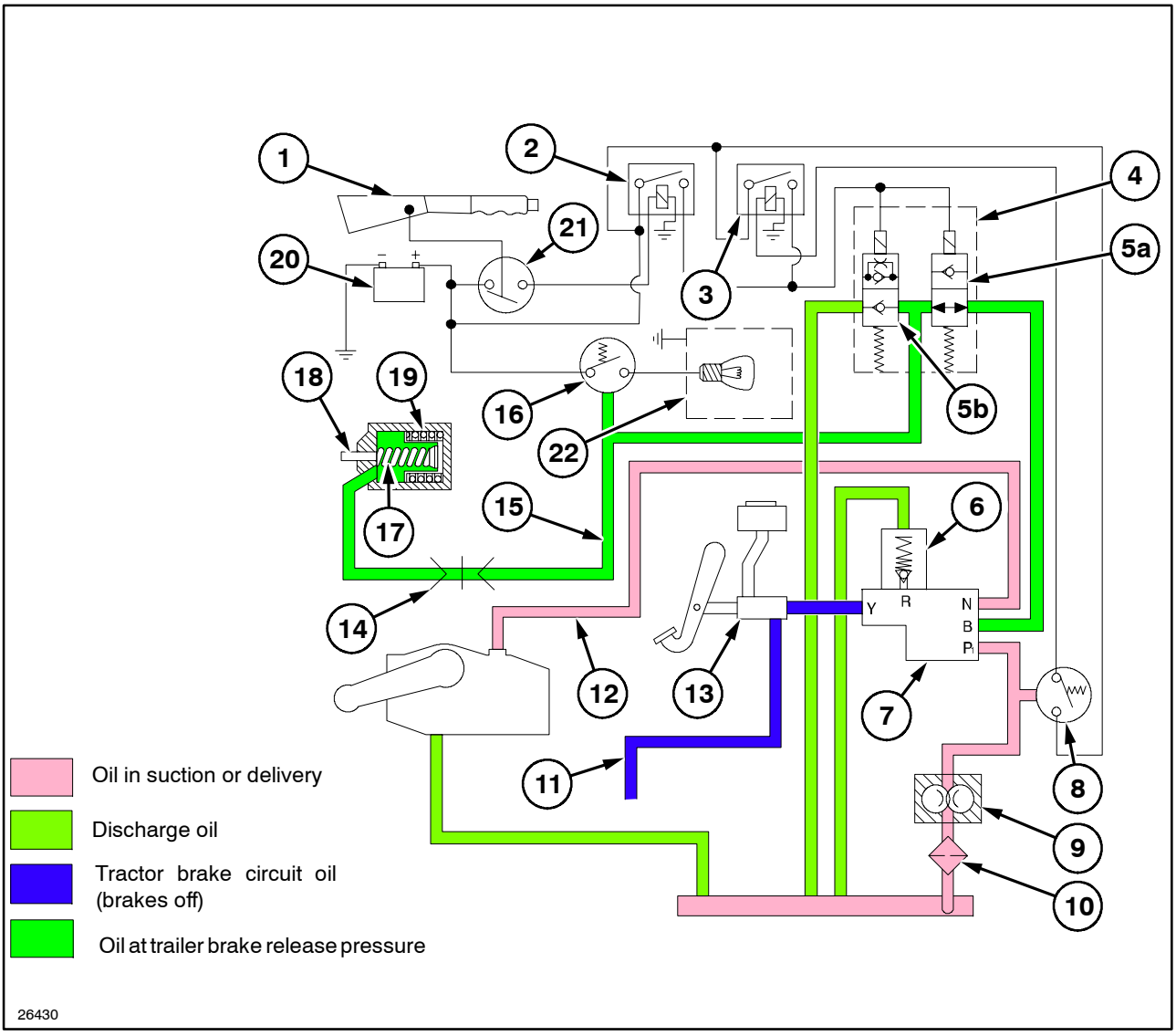
Y. From the tractor brakes.

Pressurized oil

Oil in suction, delivery or return

Oil at static rest

Pressurised tractor brake circuit oil



7

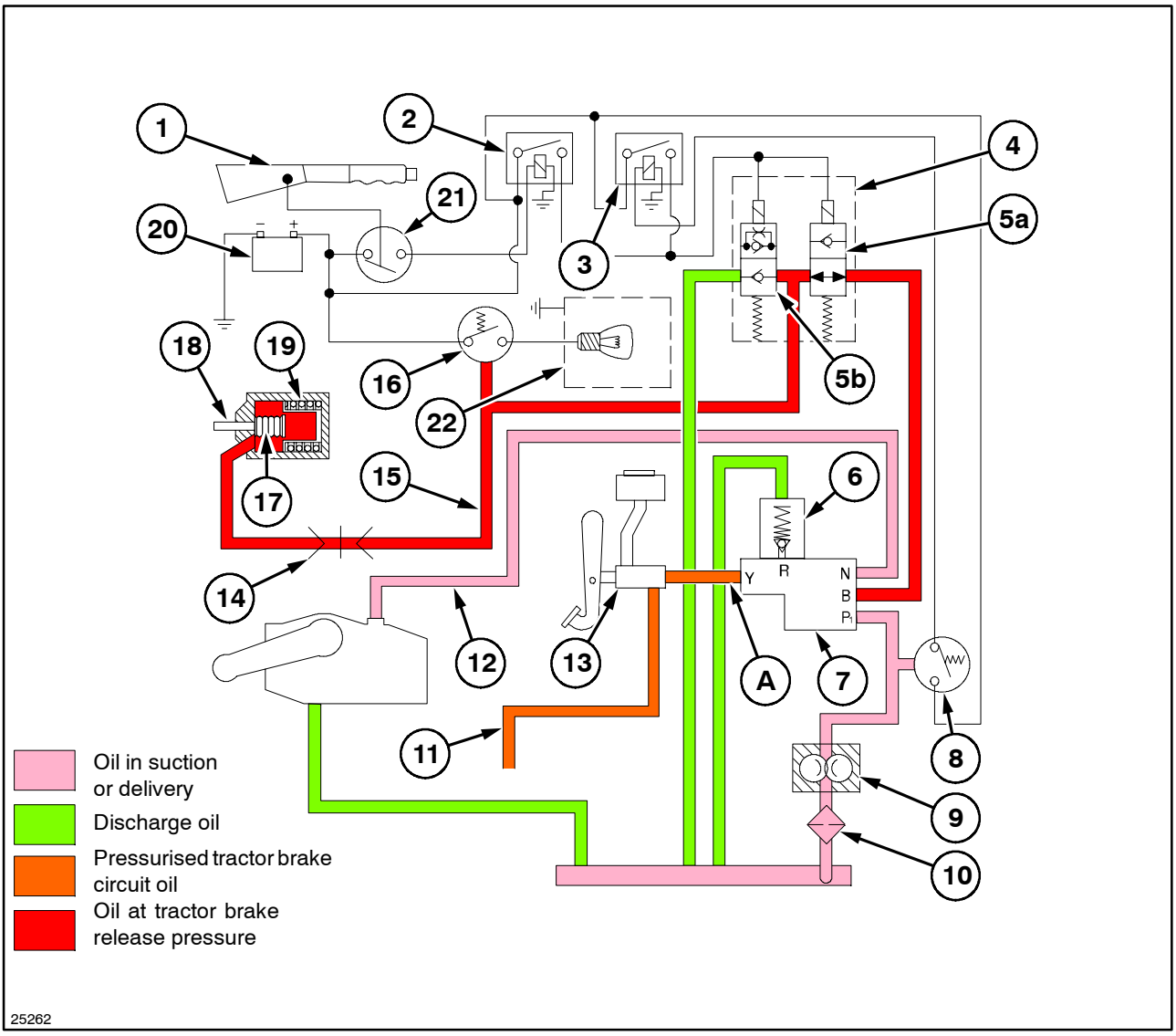
ELECTRO-HYDRAULIC OPERATION OF TRAILER BRAKE VALVE (ITALIA VERSION)

Engine running - no action on brake pedals

1. Parking brake lever - 2. Relay - parking brake warning light circuit - 3. Relay - trailer brake circuit - 4. Trailer brake control solenoid valves - 5a. Delivery solenoid valve (normally open) - 5b. Return solenoid valve (normally closed) - 6. Trailer brake release pressure control valve - 7. Trailer brake valve (see pages 4 and 5) - 8. Trailer brake circuit safety switch - 9. Hydraulic pump - 10. Filter - 11. Service brake lines - 12. Delivery lines to auxiliary control valve and hydraulic lift - 13. Service brakes pump - 14. Tractor-trailer coupling - 15. Trailer brake line - 16. Trailer brake "ON" indicator switch - 17 and 19. Springs - 18. Trailer brake control pin - 20. Battery - 21. Parking brake "ON" indicator switch - 22. Trailer brake "ON" warning light.

Oil from the hydraulic pump (9) arrives at the trailer brake valve (7), from where the majority is sent through line (12), to the auxiliary control valves and the hydraulic lift. A small amount of oil reaches valve (6), where it is discharged in order to maintain the pressure at a level of 159.54 to 174.05 psi (11 to 12 bar). Oil at a pressure of 159.54 to 174.05 psi (11 to 12 bar) flows from the trailer brake valve through solenoid valve (5a), line (15) and coupling (14) to arrive at the trailer brake. This pressure level is required to overcome the resistance of the spring (19) and move the relative spring cap. At the same time, spring (17) shifts the piston (18) to prevent any braking action on the trailer.

WARNING: *On starting the engine, in order to reduce the length of time required to bring the circuit up to the pressure required to release the trailer brake, with the parking brake lever lowered, operate the brake pedals (make sure that they are linked together). Once the trailer brake is released the warning light (22) will be switched off.*



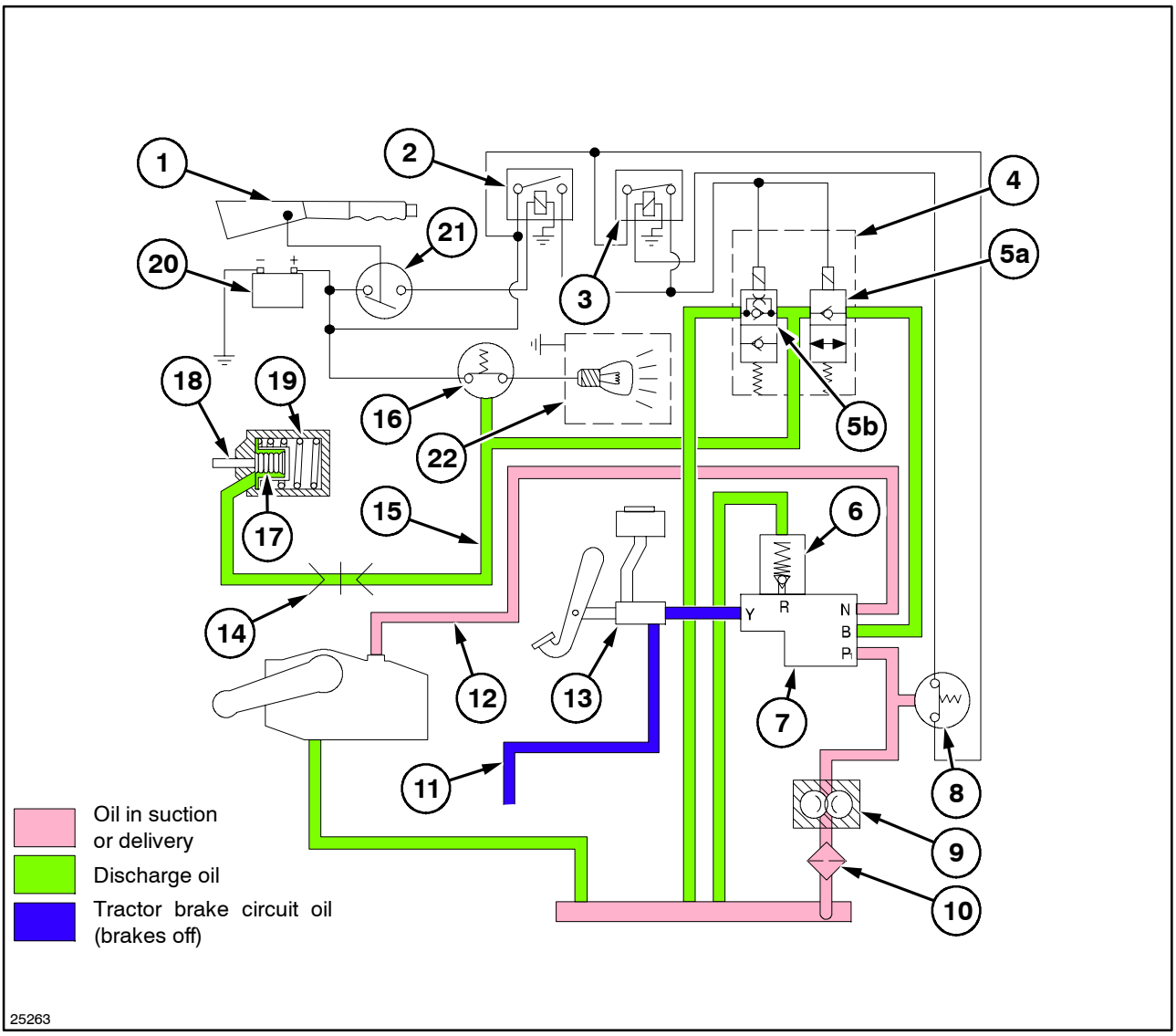
8

ELECTRO-HYDRAULIC OPERATION OF TRAILER BRAKE VALVE (ITALIA VERSION)

Engine running - brake pedals pressed

A. Line connecting brake pump (13) to trailer brake valve (7) - 1. Parking brake lever - 2. Relay - parking brake warning light circuit - 3. Relay - trailer brake circuit - 4. Trailer brake control solenoid valves - 5a. Delivery solenoid valve (normally open) - 5b. Return solenoid valve (normally closed) - 6. Trailer brake release pressure control valve - 7. Trailer brake valve (see pages 4 and 5) - 8. Trailer brake circuit safety switch - 9. Hydraulic pump- 10. Filter - 11. Service brake lines - 12. Delivery lines to auxiliary control valve and hydraulic lift - 13. Service brakes pump - 14. Tractor-trailer coupling - 15. Trailer brake line - 16. Trailer brake "ON" indicator switch - 17 and 19. Springs - 18. Trailer brake control pin - 20. Battery - 21. Parking brake "ON" indicator switch- 22. Trailer brake "ON" warning light.

On operating the brake pedals, the pressure generated in line (A), closes the valve (6) return port (R) and consequently the pressure in the delivery line from the pump (9) increases. The pressurised oil 174.05 to 2175.68 psi (12 to 150 bar) flows out of the trailer brake valve (7) through line (B) to solenoid valve (5a), which is open, and through line (15) to the trailer brake, where it overcomes the resistance of the springs (17 and 19) to shift the pin (18) and thus brake the trailer.



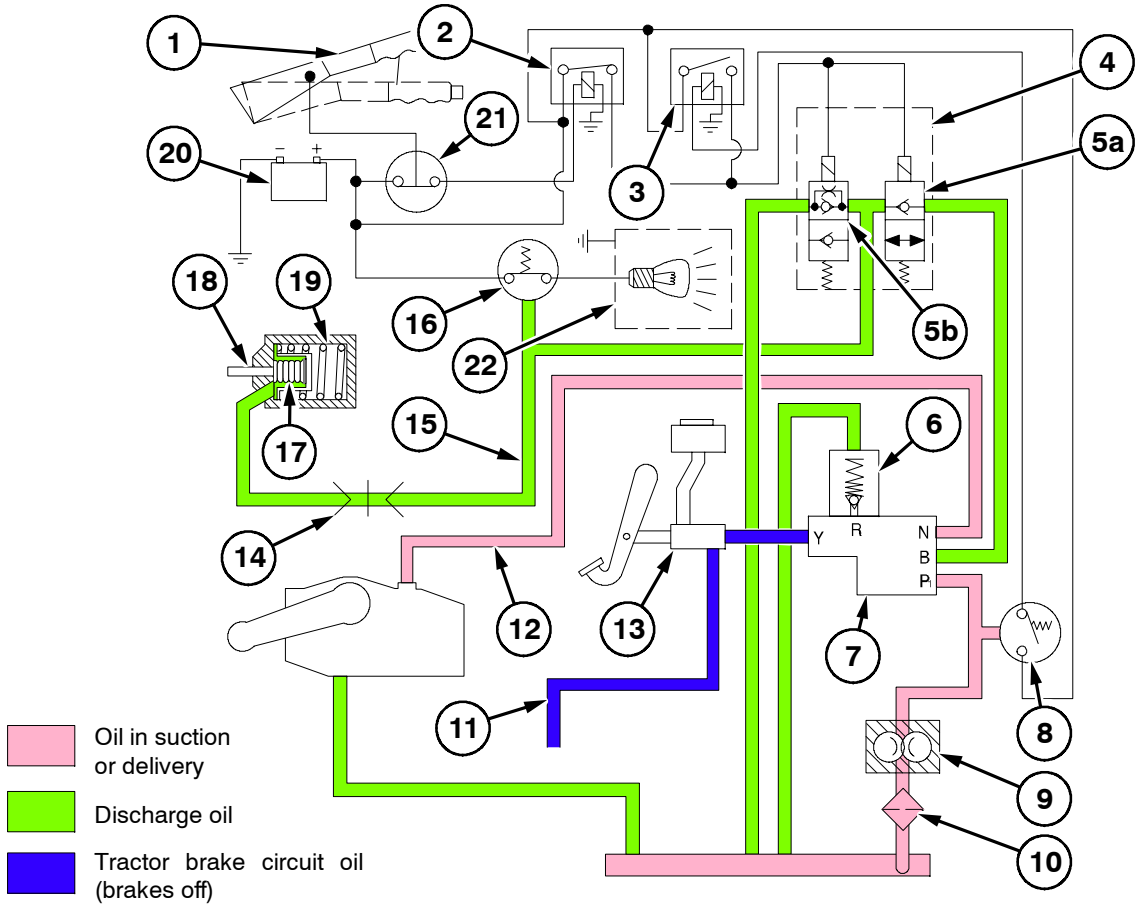
9

ELECTRO-HYDRAULIC OPERATION OF TRAILER BRAKE VALVE (ITALIA VERSION)

Engine either stopped or running but with insufficient flow from hydraulic pump

1. Parking brake lever - 2. Relay - parking brake warning light circuit - 3. Relay - trailer brake circuit - 4. Trailer brake control solenoid valves - 5a. Delivery solenoid valve (normally open) - 5b. Return solenoid valve (normally closed) - 6. Trailer brake release pressure control valve - 7. Trailer brake valve (see pages 4 and 5) - 8. Trailer brake circuit safety switch - 9. Hydraulic pump- 10. Filter - 11. Service brake lines - 12. Delivery lines to auxiliary control valve and hydraulic lift - 13. Service brakes pump - 14. Tractor-trailer coupling - 15. Trailer brake line - 16. Trailer brake "ON" indicator switch - 17 and 19. Springs - 18. Trailer brake control pin - 20. Battery - 21. Parking brake "ON" switch - 22. Trailer brake "ON" warning light.

When the engine is stopped, or running but with insufficient flow from the hydraulic pump (9), the oil pressure at the trailer brake valve (7) is either too low or non-existent, and this condition causes the safety switch to close (8). The closure of switch (8) allows electrical current to energise relay (3), which closes the circuit to the solenoid valves (5a and 5b), thereby closing the former and opening the latter. In this condition, the oil in the trailer brake and line (15), under the action of spring (19), is discharged through solenoid valve (5b), and the braking action is obtained mechanically by the pressure of spring (19) on pin (18). The pressure drop caused by the oil discharging allows switch (16) to close and thereby allow current to reach and illuminate warning light (22) on the control panel.



10

ELECTRO-HYDRAULIC OPERATION OF TRAILER BRAKE VALVE (ITALIA VERSION)

Engine running - with parking brake on

1. Parking brake lever - 2. Relay - parking brake warning light circuit - 3. Relay - trailer brake circuit - 4. Trailer brake control solenoid valves - 5a. Delivery solenoid valve (normally open) - 5b. Return solenoid valve (normally closed) - 6. Trailer brake release pressure control valve - 7. Trailer brake valve (see pages 4 and 5) - 8. Trailer brake circuit safety switch - 9. Hydraulic pump - 10. Filter - 11. Service brake line - 12. Delivery line to auxiliary control valves and hydraulic lift - 13. Service brakes pump - 14. Tractor-trailer coupling - 15. Trailer brake line - 16. Trailer brake "ON" indicator switch - 17 and 19. Springs - 18. Trailer brake control pin - 20. Battery - 21. Parking brake "ON" indicator switch- 22. Trailer brake "ON" warning light. On applying the parking brake (1), switch (21) is closed. This allows electrical current to energise relay (2), which closes the circuit to the solenoid valves (5a and 5B), thereby closing the former and opening the latter. In this condition, the oil in the trailer brake and line (15), under the action of spring (19), is discharged through solenoid valve (5b), and the braking action is obtained mechanically by the pressure of spring (19) on pin (18). The pressure drop caused by the oil discharging allows switch (16) to close and thereby allow current to reach and illuminate warning light (22) on the control panel.

WARNING: *After applying the parking brake, wait approximately 10 seconds before shutting off the engine, in order to allow all the oil to be discharged from the trailer brake cylinder and thus obtaining optimum braking.*

FUNCTIONAL TESTING AND TROUBLESHOOTING OF TRAILER BRAKE VALVE - ITALIA VERSION

Test conditions

Oil temperature 104° to 122 °F (40° to 50 °C).

Engine speed: 1000 rpm.

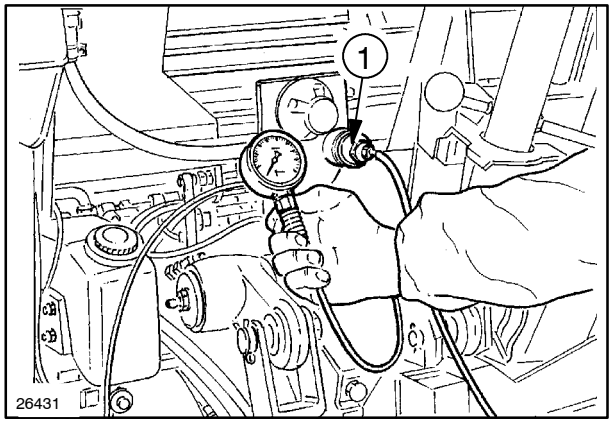
Electrical system powered.

Parking brake disengaged.

Trailer brake release pressure test.

Proceed as follows:

1. Insert union **293190** (1) in the trailer brake coupling and connect to the pressure gauge with scale 0 to 40 kg/cm^2 from kit **380000240**.
2. With the engine and oil at the aforementioned conditions, the pressure should be 159.54 to 174.05 psi (11 to 12 bar).
3. Check that the warning light (22, fig. 10) is not illuminated.
4. Apply the parking brake and disconnect the pressure gauge and union **293190** (1).



11

FAULT DIAGNOSIS

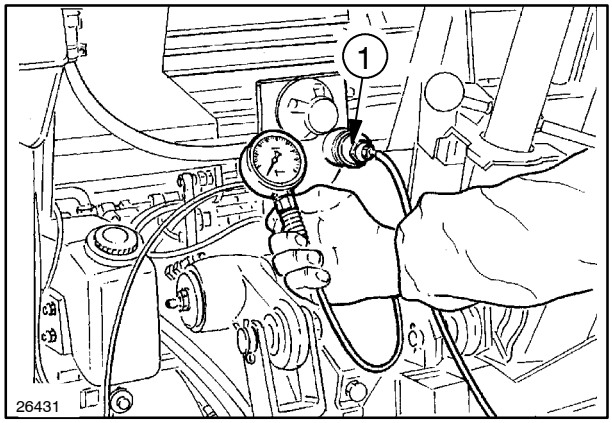
Problems	Possible Causes	Solutions
Trailer brake release pressure = 0 bar (warning light 22, fig. 10 ON).	1. Parking brake (1, fig. 10) engaged.	Disengage parking brake.
	2. Trailer brake release pressure control valve (6) incorrectly adjusted.	Replace the valve.
	3. Trailer brake circuit safety switch (8) faulty.	Replace switch.
	4. Hydraulic pump (9) faulty.	Overhaul or replace hydraulic pump.
	5. Delivery line solenoid valve (5a) locked in closed position.	Free or replace the solenoid valve.
	6. Discharge line solenoid valve (5b) locked in open position.	Free or replace the solenoid valve.
Trailer brake release pressure 0 to 159.54 psi (0 to 11 bar).	1. Trailer brake release pressure control valve (6) incorrectly adjusted.	Replace the valve.
Trailer brake release pressure correct, but warning light (22) illuminated.	1. Trailer brake warning light switch (16) faulty.	Replace switch.
Trailer brake release pressure incorrect, but warning light (22) not illuminated.	1. Warning light (22) bulb faulty.	Change the lamp bulb.
	2. Trailer brake warning light switch (16) faulty.	Replace switch.

NOTE: *Switch (8) can be identified by the red paint mark between the two terminals.*

TESTING THE SETTING OF THE TRAILER BRAKE SYSTEM PRESSURE CONTROL VALVE INCORPORATED IN THE TRAILER BRAKE CONTROL VALVE

Proceed as follows:

1. Insert union **293190** (1) in the trailer brake coupling and connect to the pressure gauge with scale 0 to 40 kg/cm^2 from kit **380000240**.
2. With the engine and the oil in the test conditions described at the beginning of the chapter, apply a force of 30 to 35 daN (29.4 to 34.3 kg/cm^2) to the service brake pedals; the pressure reading on the gauge should be 1958.11 to 2103.15 psi (135 to 145 bar).
3. Apply the parking brake and disconnect the pressure gauge and union **293190** (1).



12

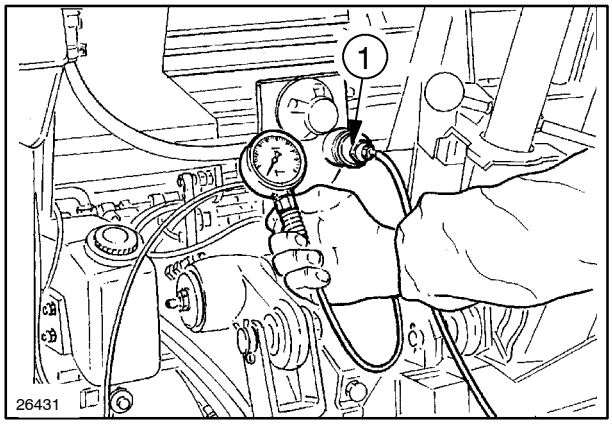
FAULT DIAGNOSIS

Problems	Possible Causes	Solutions
Pressure above or below prescribed range.	1. Pressure control valve (6, fig. 10) of trailer brake auxiliary control valve faulty.	Replace trailer brake auxiliary control valve.
	2. Hydraulic pump (9) faulty.	Replace pump.

TESTING THE HYDRAULIC SYSTEM FOR LEAKAGE

Proceed as follows:

1. Insert union **293190** (1) in the trailer brake coupling and connect to the pressure gauge with scale 0 to 250 kg/cm^2 from kit **380000240**.
2. With the engine and the oil in the test conditions described at the beginning of the chapter, apply a force of 30 to 35 daN (29.4 to 34.3 kg/cm^2) to the service brake pedals and with a pressure of 1958.11 to 2103.15 psi (135 to 145 bar) check that within 10 seconds the number of pressure peaks is under 10.
3. Apply the parking brake and disconnect the pressure gauge and union **293190** (1).



13

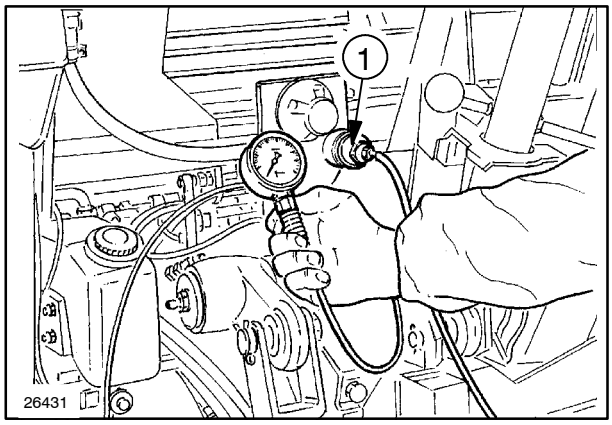
FAULT DIAGNOSIS

Problems	Possible Causes	Solutions
On applying the prescribed force on the service brake pedals, there are an excessive number of pressure peaks over a 10-second period.	1. Oil leaks in the hydraulic system.	Find and eliminate the leaks.
	2. Excessive leakage from the solenoid valve (5b, fig. 10).	Replace the solenoid valve.
	3. Excessive leakage from trailer brake control valve (7).	Replace trailer brake auxiliary control valve.

CHECKING THAT TRAILER BRAKE RELEASE PRESSURE IS NULLIFIED WHEN THE PARKING BRAKE IS APPLIED

Proceed as follows:

1. Insert union **293190** (1) in the trailer brake coupling and connect to the pressure gauge with scale 0 to 40 kg/cm^2 from kit **380000240**.
2. With the engine and the oil in the test conditions described at the beginning of the chapter, pull the parking brake lever (1, fig. 10).
3. Check that the pressure is 0 bar and that warning light (22, fig. 10) is ON.
4. With the parking brake applied, disconnect the pressure gauge and union **293190** (1).



14

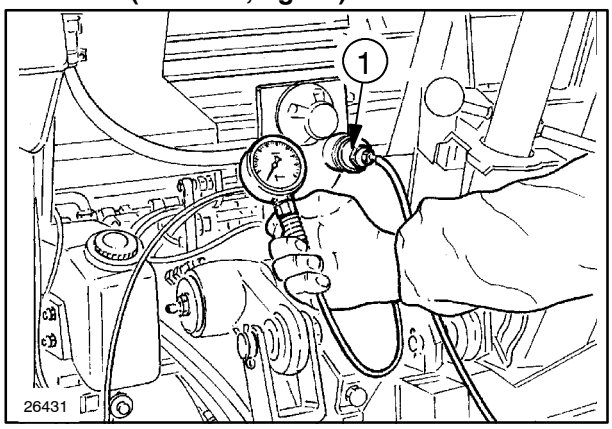
FAULT DIAGNOSIS

Problems	Possible Causes	Solutions
When the parking brake is applied the trailer brake release pressure is not nullified.	1. Parking brake switch (21, fig. 10) faulty.	Replace switch.
	2. Parking brake indicator relay (2) faulty.	Replace relay.
	3. Discharge line solenoid valve (5b) locked in closed position or faulty.	Free or replace the solenoid valve.

CHECK CALIBRATION ON SWITCHES (8 and 16, fig. 10).

Proceed as follows:

1. Insert union **293190** (1) in the trailer brake coupling and connect to the pressure gauge with scale 0 to 40 kg/cm^2 from kit **380000240**.
2. Without applying the service and parking brakes, operate the control lever of an auxiliary control (until the corresponding pressure relief valve is activated), hold this position for a few seconds then suddenly release the control lever.
3. Check that the parking brake release pressure remains at the prescribed level of: 159.54 to 174.05 psi (11 to 12 bar).
4. Apply the parking brake and disconnect the pressure gauge and union **293190** (1).



15

FAULT DIAGNOSIS

Problems	Possible Causes	Solutions
On carrying out the operation described above, the trailer brake release pressure is nullified permanently.	1. Trailer brake circuit safety switch (8, fig. 10) setting higher than the nominal pressure 43.51 ± 7.25 psi (3 ± 0.5 bar).	Replace switch.
	2. Switches (8 and 16) installed in incorrect positions, or electrical leads connected incorrectly.	Install the two switches in their correct positions or swap over the electrical power leads.

NOTE: *Switch (8) can be identified by the red paint mark between the two terminals.*

SECTION 35 - HYDRAULIC SYSTEMS

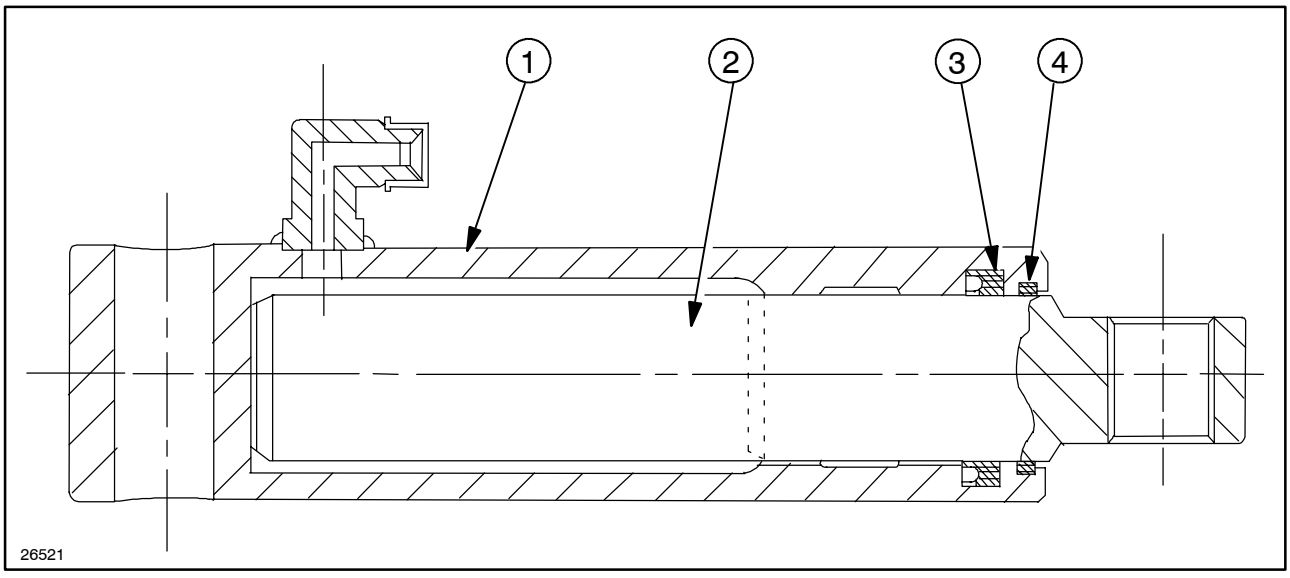
Chapter 5 - Supplementary cylinder

CONTENTS

Operation	Description	Page
	Data	1
	Cross-sectional views	1
	Description and Operation	1
35 116 30	Supplementary cylinder R.I.	2
35 116 33	Supplementary cylinder D.A.	2

DATA

Type		single-acting
Amount		no. 1
Piston rod diameter	in. (mm)	1.9685 (50)
Rod stroke	in. (mm)	5.9055 (150)



1

Cross-sectional view of supplementary cylinder

1. Supplementary cylinder body.
2. Rod.
3. Seal.
4. Dust seal.

DESCRIPTION AND OPERATION

In order to increase the lifting power a supplementary hydraulic cylinder can be connected to the right-hand arm of the lift, pivoting on a support fitted on the right-hand final drive casing.

The single-acting supplementary cylinder is controlled by the oil from the lift control valve, which also acts on the lift internal cylinder.

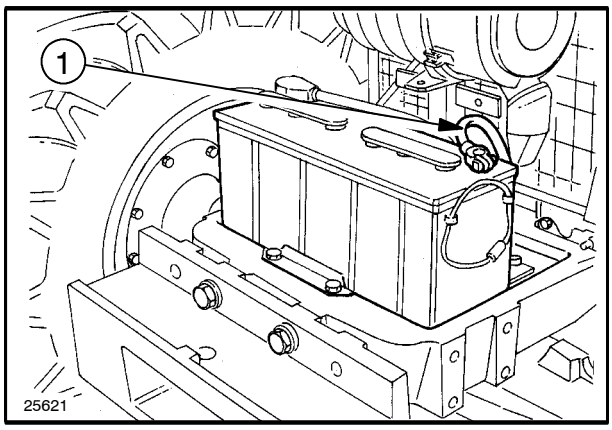
Op. 35 116 30
SUPPLEMENTARY CYLINDER R.I.

CAUTION

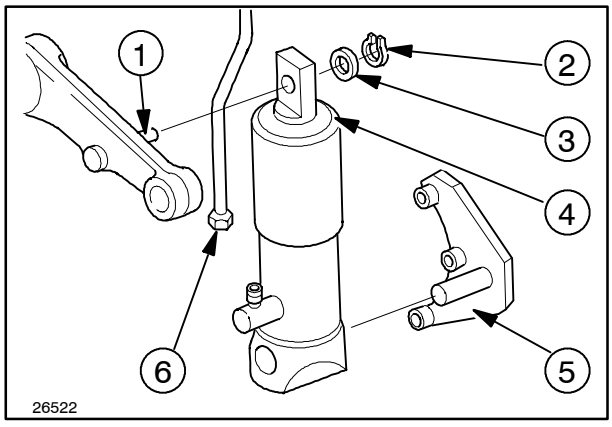
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

To remove the supplementary cylinder, proceed as follows.

1. Raise engine cover.
2. Detach negative lead (1) from battery and insulate.
3. Fully lower the lift arms.
4. Unscrew the three pivot support (5, fig. 3) retaining nuts, secured to the right-hand final drive.
5. Remove the support (5), snap ring (2) and washer (3) from the pin (1) installed on the lift arm.
6. Disconnect the oil delivery line (6) and remove the supplementary cylinder (4).
7. To refit the supplementary cylinder follow the disassembly operations in reverse order.



2



3

Op. 35 116 33
SUPPLEMENTARY CYLINDER D.A.

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

To disassemble the supplementary cylinder, proceed as follows

1. Extract the rod (2, fig. 1) from the supplementary cylinder and check that it is not deformed or scored.
2. Check the seal (3, fig. 1) and the dust seal (4), and replace if necessary.
3. Lubricate the three parts with the correct oil and insert in the rod (2).

SECTION 35 - HYDRAULIC SYSTEMS

Chapter 6 - Electronic draft control

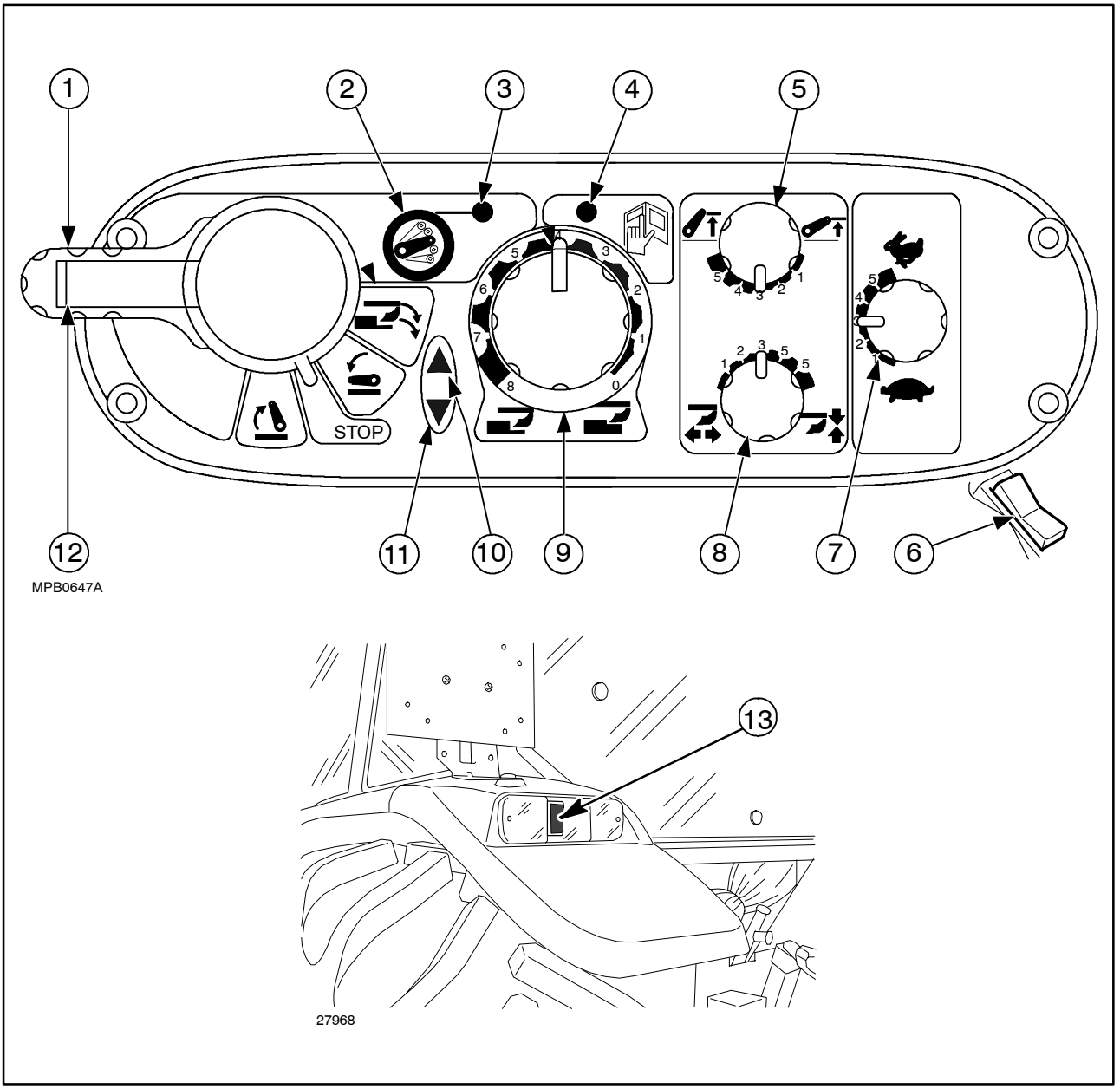
CONTENTS

Operation	Description	Page
	Data	2
	Tightening Torques	4
	Tools	4
	Details of electronic lift components	5
	Description and Operation	8
	Fault code decoding	12
	Diagnostics	13
35 130 30	Lift electronic control centre – Replacement	47
35 130 31	Electronic lift control panel R.I.	48
35 130 36	Lift arm potentiometer – Replacement	49
35 130 56	Draft sensor R.I.	50
35 134 04	Electronic lift calibration	52
35 134 30	Electronic draft control R.I.	54
35 138 20	Hydraulic control valve R. I.	60

CAUTION

Observe the following precautions when carrying out arc welding on a tractor fitted with an electronic lift.

- Where possible, remove the part or tool that requires arc welding from the tractor.
- Disconnect both battery leads. Isolate the ends of the leads to prevent then from making contact with each other, or with the tractor.
- Position the welder ground clamp as near as possible to the area where welding is taking place.
- Remove the electronic control units located on the tractor if welding is to be carried out near these control units.
- The welding leads must not be positioned on, near or come into contact with any other electric leads or electronic components whilst welding is taking place.



1

ELECTRONIC DRAFT CONTROL DATA

Type	with controlled position/draft and float setting
Controls	by means of an electronic control unit located inside the panel on the right-hand side of the driving position, internal and external controls. 1. Raise and lower control lever (four positions); 2. Damping function ON push-button (Damping); 3. Damping function ON indicator; 4. Troubleshooting indicator; 5. Lift arms raise limit adjustment knob; 6. Automatic slip control push-button (optional); 7. Lift arms descent speed adjustment knob; 8. Position/draft sensitivity adjustment knob; 9. Working depth adjustment knob; 10. Arms raised indicator; 11. Arms lowered indicator; 12. Locking push-button, in lifting position (STOP), of the lever (1).
Ground position control.	by means of two push-buttons (13) fitted on the rear mudguards.

ELECTRONIC DRAFT CONTROL DATA

Diameter of arm lifting shaft in relation to bushings:		
- right-hand side	in. (mm)	2.1641 to 2.1653 (54.970 to 55.000)
- left-hand side	in. (mm)	1.8887 to 1.8897 (47.975 to 48.000)
Internal diameter of bushings fitted on lift body:		
- right-hand side	in. (mm)	2.1692 to 2.1725 (55.100 to 55.184) ([1])
- left-hand side	in. (mm)	1.8937 to 1.8970 (48.100 to 48.184) ([1])
- Clearance between lifting arm shaft and relative right-hand side bushings	in. (mm)	0.0039 to 0.0084 (0.100 to 0.214)
- Clearance between lifting arm shaft and relative left-hand side bushings	in. (mm)	0.0039 to 0.0082 (0.100 to 0.209)
- Interference between bushings and relative seats	in. (mm)	0.0025 to 0.0063 (0.065 to 0.161)
Axial clearance of shaft complete with lift arms	in. (mm)	0.0078 to 0.0551 (0.2 to 1.4)

([1]) Value to be obtained after obtaining interference fit without grinding operations.

IMPLEMENT HITCHING DEVICE DATA

Type		three-point linkage
Category:		2[a]
Draft control		by means of lower arms with draft sensors
- at link ends of horizontal arms	lbs. (kg)	7363.43 (3340)
- Models TL70 and TL80 (with an additional jack)	lbs. (kg)	9810.57 (4450)
- Models TL90 and TL100 (with two additional jacks)	lbs. (kg)	11155.39 (5060)
- with centre of gravity at 24.0157 in. (610 mm) from link ends:	lbs. (kg)	7076.83 (3210)
- Models TL70 and TL80 (with an additional jack)	lbs. (kg)	8168.12 (3705)
- Models TL90 and TL100 (with two additional jacks)	lbs. (kg)	8967.79 (4065)

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Lift			
Bolts securing front cover to lift	M 8 x 1.25	26	2.7
Cylinder safety valve (C_6), page 8	M 20 x 1.5	83	8.5
Lift cylinder retaining bolts:			
- front	M 14 x 1.5	157	16
- upper	M 16 x 1.5	260	26.5
Implement hitching device			
Lateral stabiliser strut support retaining bolts	M 16 x 1.5	221	22.5
Pick-up hitch hook support retaining bolts	M 16 x 1.5	221	22.5

TOOLS

WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

380000224 Hydraulic lift lifting hook.

380000238 Bracket to raise hydraulic lift.

X 380000225 Ring for fitting piston with lift seals.

X 380000262 Punch for fitting lift arm shaft seal.

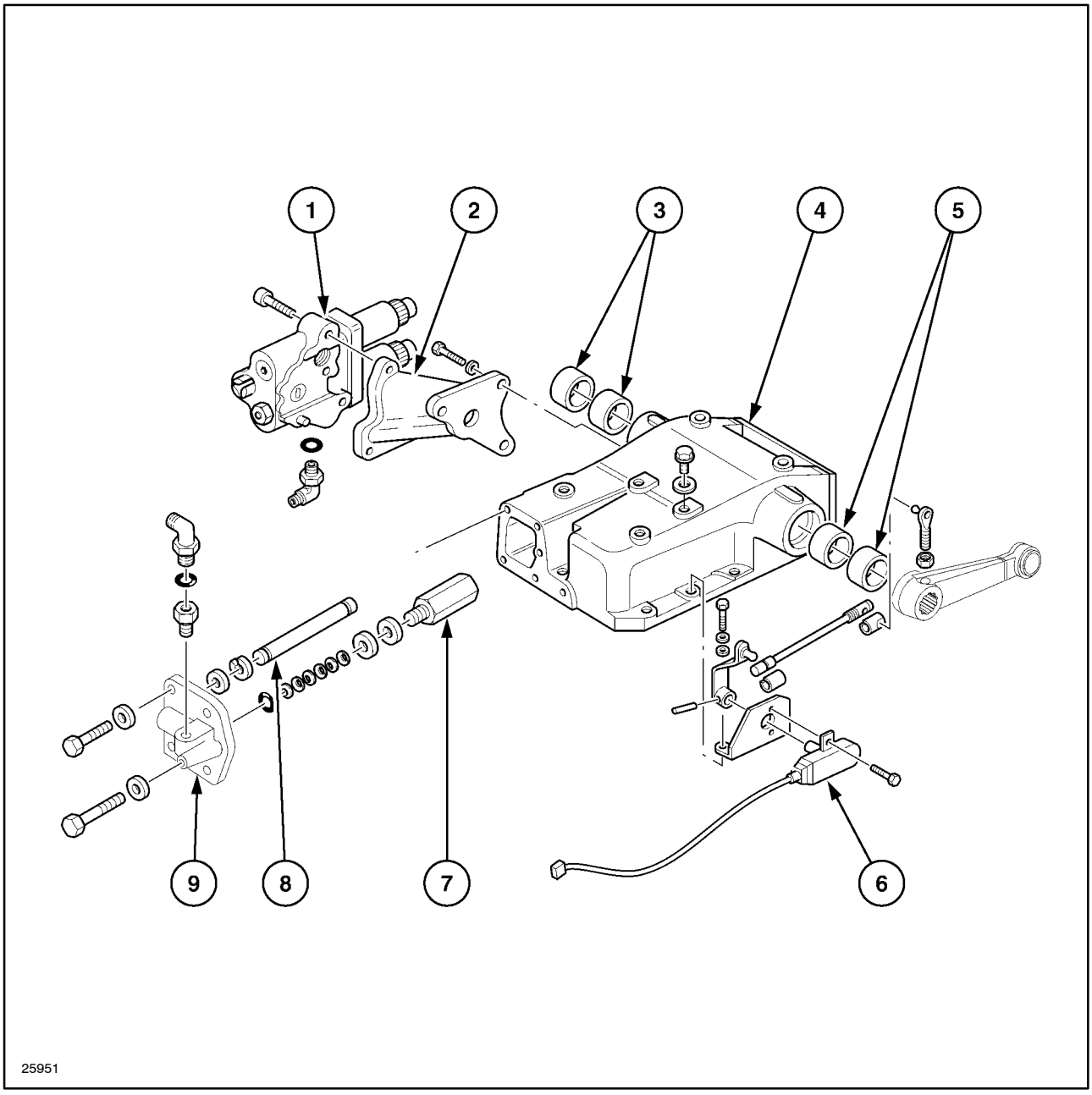
X 380000230 Wrench for cylinder safety valve setting ring nut.

X 380000231 Wrench for lift pressure relief setting ring nut.

X 380000240 Universal pressure control kit.

X 380000215 Hand pump for valve calibration.

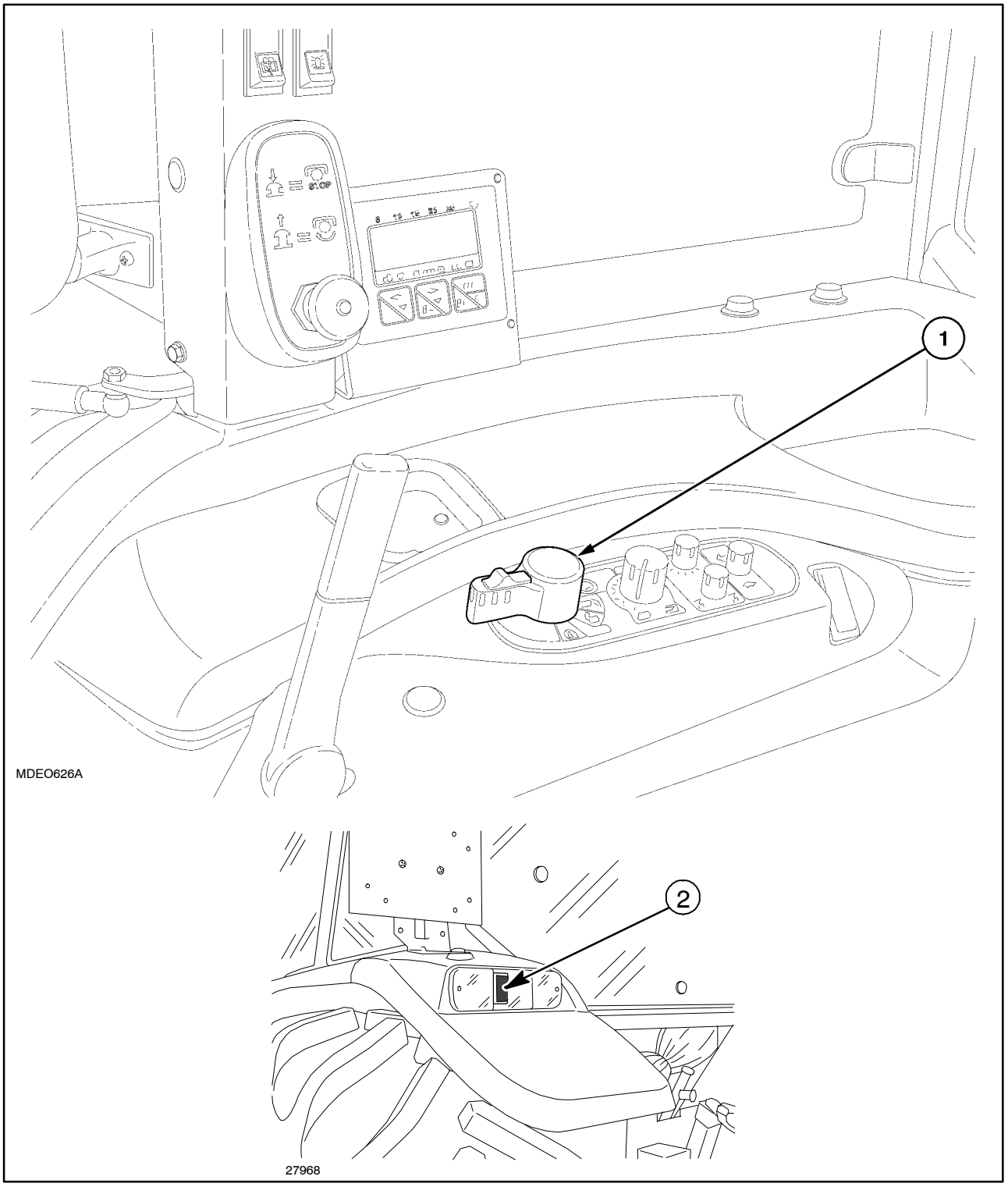
X 380000218 Union for cylinder safety valve calibration.



2

View of electronic lift components.

1. Hydraulic control valve.
2. Spacer for hydraulic control valve.
3. Right-hand side bushing.
4. Lift body.
5. Left-hand side bushing.
6. Lift arm position potentiometer.
7. Cylinder safety valve.
8. Lift cylinder control internal line.
9. Cover.

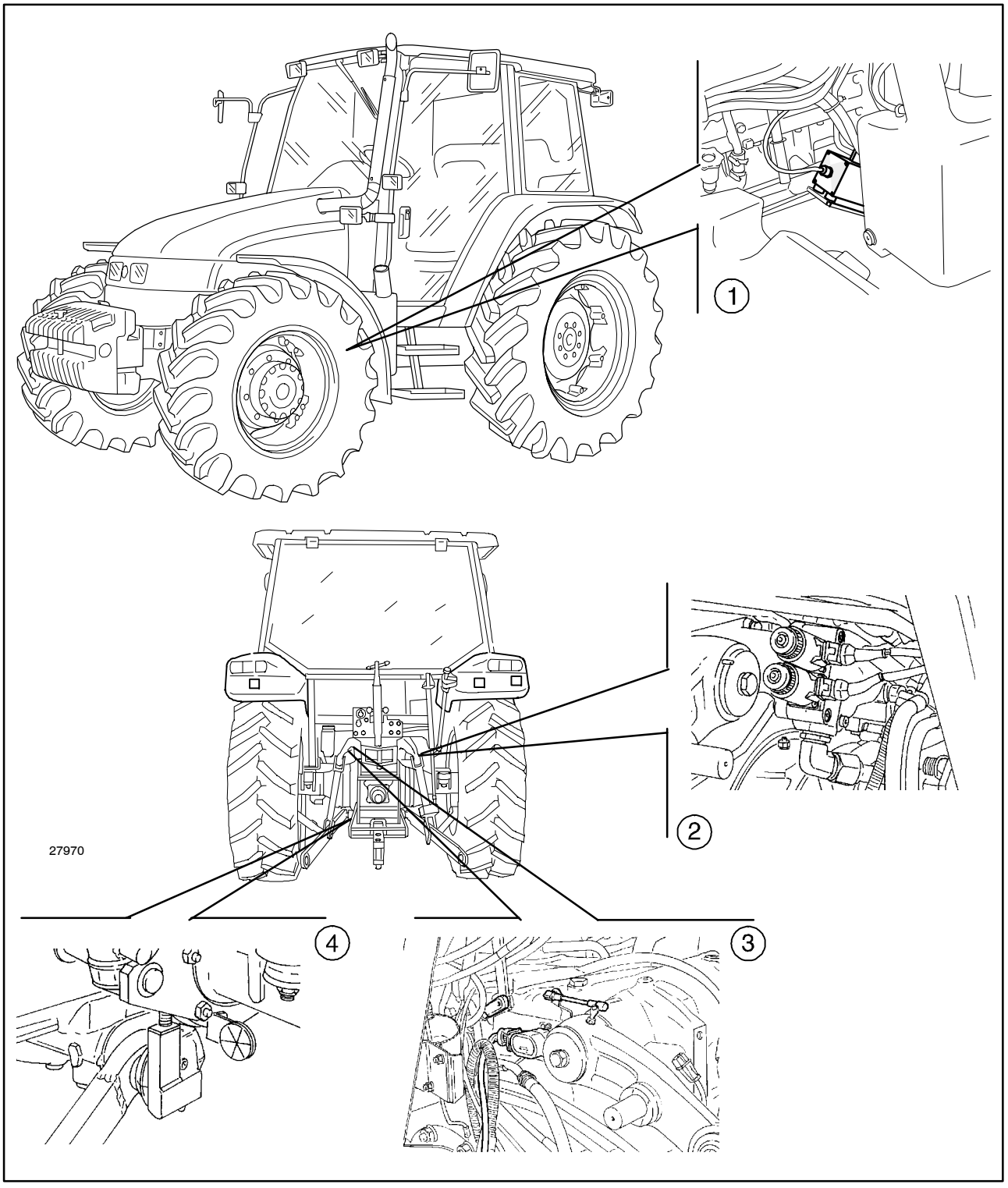


3

Electronic lift controls positions

1. Internal controls: the console houses all the controls and indicators (see fig. 1).

2. External lower/lift switch on both mudguards.



4

Location of radar, control valve and draft sensors

1. Radar.
2. Hydraulic control valve.
3. Position reading sensor.
4. Draft sensor (one on each side).

DESCRIPTION AND OPERATION

One way of obtaining a more constant control of the working depth is to take advantage of the fact that the towing load increases with the depth of the implement.

If the implement is maintained at a fixed draft, depending on the type of ground being worked, the depth of the implement will vary (given that the tractor speed remains constant).

The electronically controlled hydraulic lift provides a precise method for controlling the implement draft and ground penetration depth, independently of whether the implement is totally or partially carried.

The operating principle of the electronic draft control lift is the measurement of the implement draft variation, using two load measuring pins that read each load variation.

A microprocessor converts these variations into electric signals that activate the hydraulic control valve, lifting or lowering the arms and, therefore, maintaining a constant draft on the implement.

The regularity and precision obtained during operation give this system a clear advantage over traditional mechanical systems.

The electrical signals received by the microprocessor, to raise or lower the hydraulic lift arms according to the requests for position and draft control, are provided by four main sources:

the lift control lever, the lift arm position sensor potentiometer, the load measuring pins and the draft/position mix knob located on the control panel.

The input signal is also influenced by ulterior signals from the arm descent speed and maximum lifting height controls.

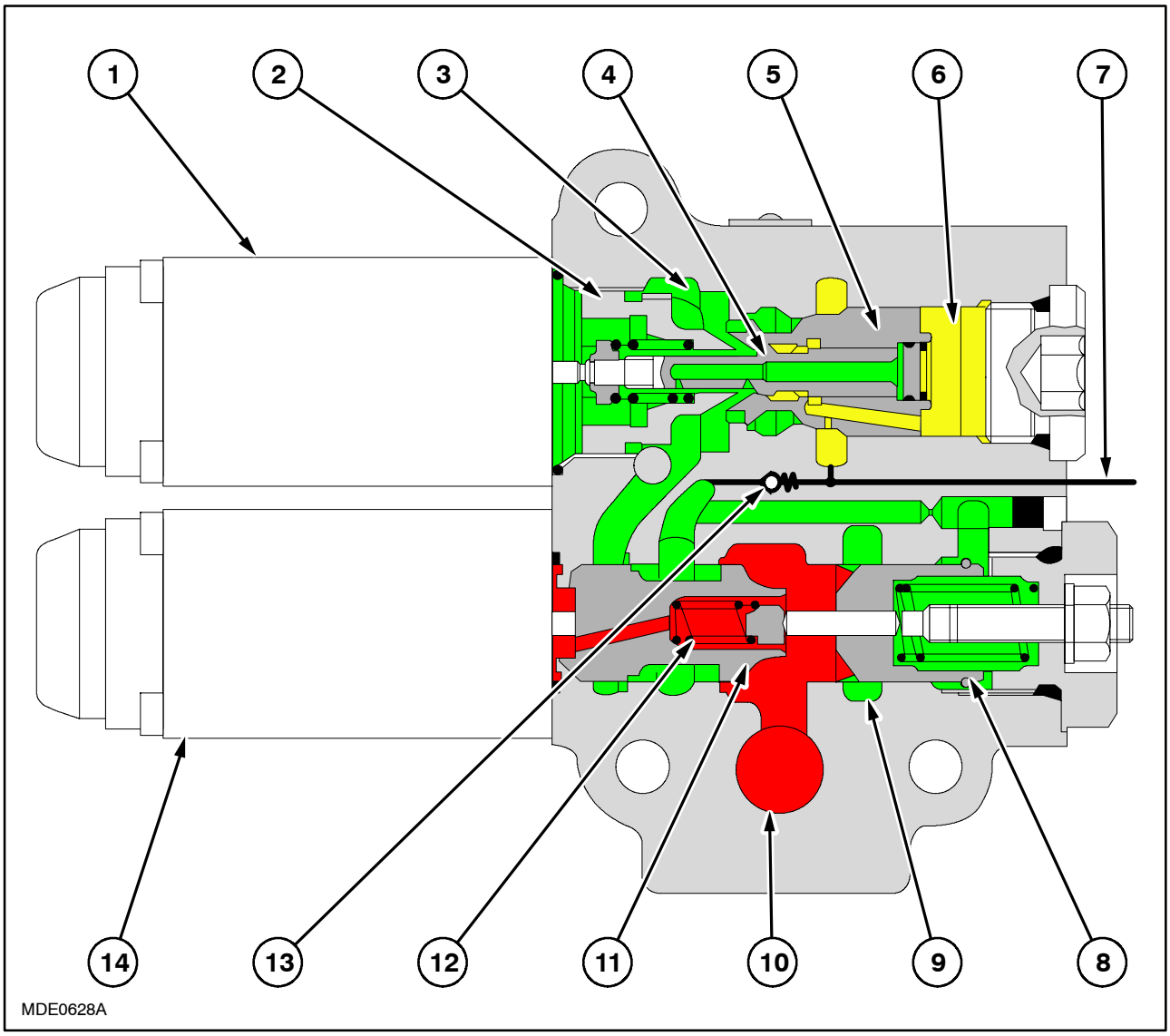
When the control push button is activated to lift or lower the arms, the processor transmits a signal to the hydraulic control valve, which accordingly lifts or lowers the implement.

Whilst the position of the lift arms changes, the microprocessor receives a feedback signal from the arm position sensor potentiometer.

When the lift arms reach the selected position, the control signal from the microprocessor to the hydraulic control valve is deactivated, leaving the lift arms in the required position.

When draft control is selected, the working depth of the implement is also controlled by the draft applied to the implement by means of the lower arms, and measured by the draft sensors and sent to the control unit.

If the implement draft increases, exceeding the value selected by the operator, the microprocessor sends a signal to the hydraulic control valve, raising the implement so as to maintain the draft at the selected values.



5

Electronic draft control functional diagram. Neutral phase

1. Lowering solenoid valve.
2. Lowering valve fixed seat.
3. Discharge chamber.
4. Lowering valve actuator.
5. Lowering valve.
6. Lowering valve chamber.
7. To lifting cylinder.
8. Pressure compensating valve.
9. Excess pressure discharge chamber.
10. Oil from pump.
11. Lifting valve.
12. Valve calibration spring (11).
13. Non-return valve.
14. Lifting solenoid valve.

Oil at static rest.

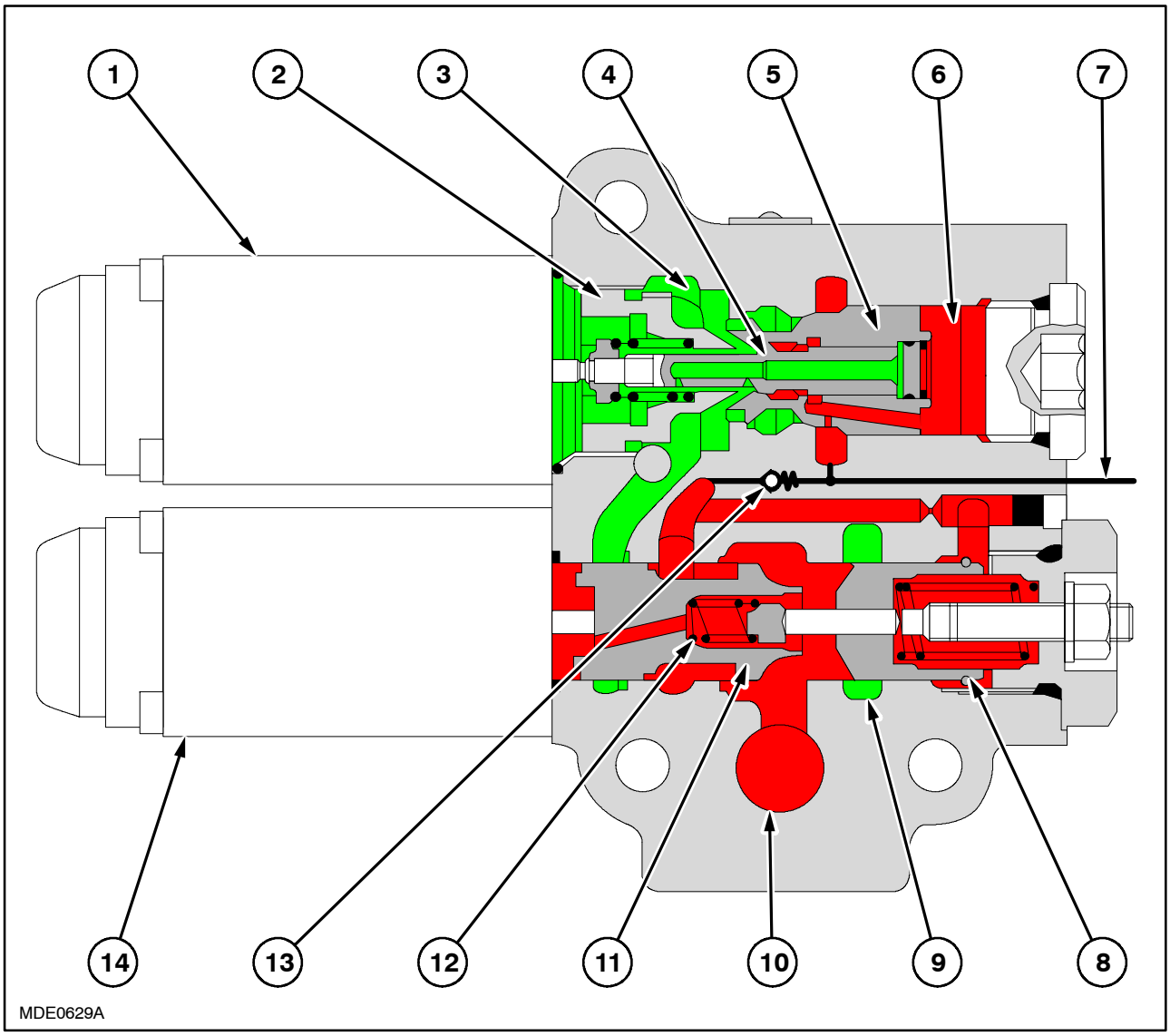
Pressurized oil.

Discharge oil.

DESCRIPTION AND OPERATION

Neutral phase

The oil from pump (10) meets the closed lifting valve (11), therefore the full pump delivery will be discharged in chamber (9). The lowering valve (5) is closed and the lifting cylinder oil remains trapped between the valve and the check valve (13), maintaining the implement in the desired position.



6

Electronic draft control functional diagram. Lifting phase

1. Lowering solenoid valve.
2. Lowering valve fixed seat.
3. Discharge chamber.
4. Lowering valve actuator.
5. Lowering valve.
6. Lowering valve chamber.
7. To lifting cylinder.
8. Pressure compensating valve.
9. Excess pressure discharge chamber.
10. Oil from pump.
11. Lifting valve.
12. Valve calibration spring (11).
13. Non-return valve.
14. Lifting solenoid valve.

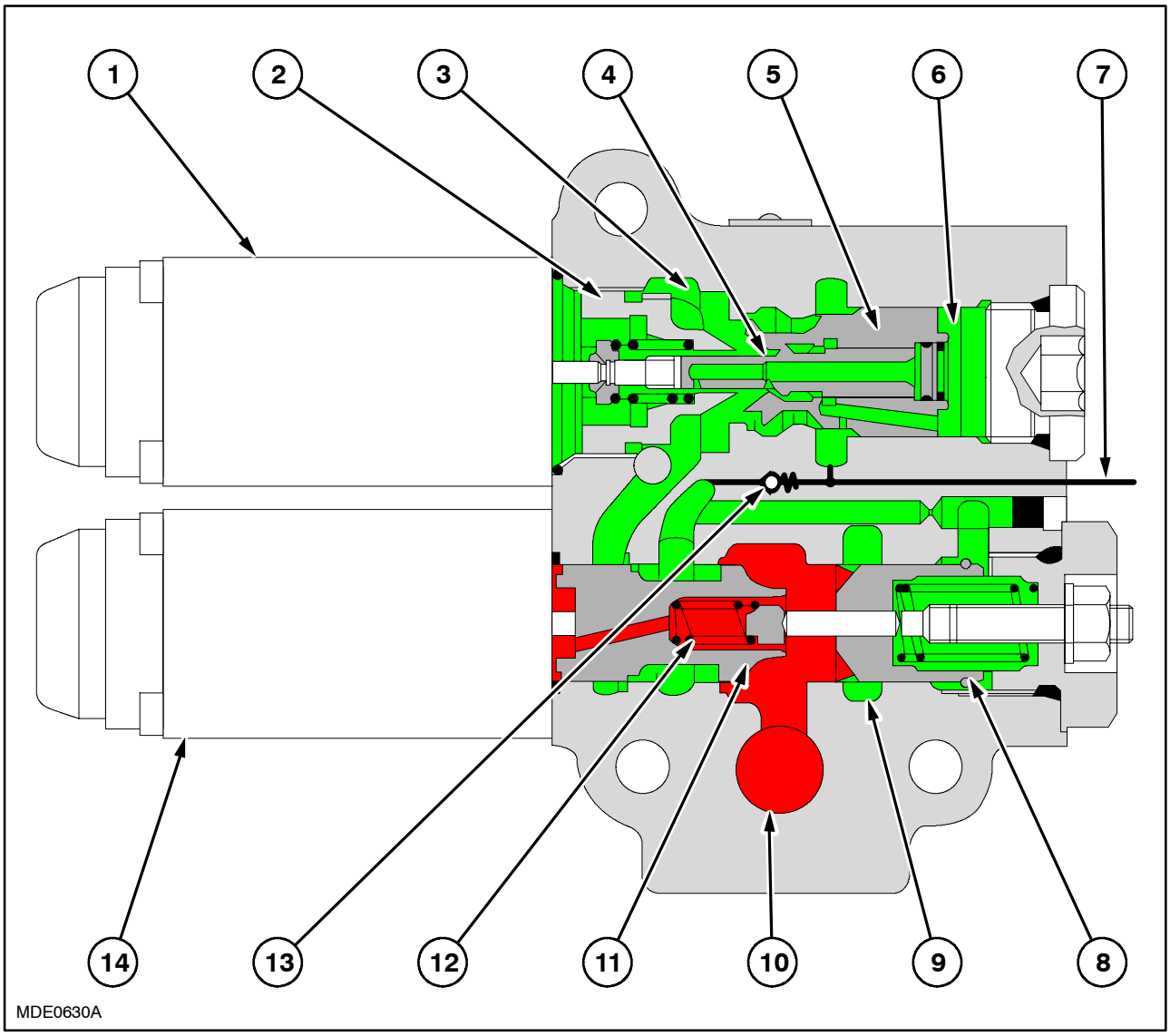
Pressurized oil.

Discharge oil.

DESCRIPTION AND OPERATION

Lifting phase

The solenoid valve (14), overcomes the resistance of the spring (12) and moves the lifting valve (11), the oil from pump (10) flows through the check valve (13), to lifting cylinder (7) and the pressure compensating valve (8), which adjusts the pressure by discharging any excess pressure through discharge duct (9).



7

Electronic draft control functional diagram. Lowering phase

1. Lowering solenoid valve.
2. Lowering valve fixed seat.
3. Discharge chamber.
4. Lowering valve actuator.
5. Lowering valve.
6. Lowering valve chamber.
7. To lifting cylinder.
8. Pressure compensating valve.
9. Excess pressure discharge chamber.
10. Oil from pump.
11. Lifting valve.
12. Valve calibration spring (11).
13. Non-return valve.
14. Lifting solenoid valve.

Pressurized oil.

Discharge oil.

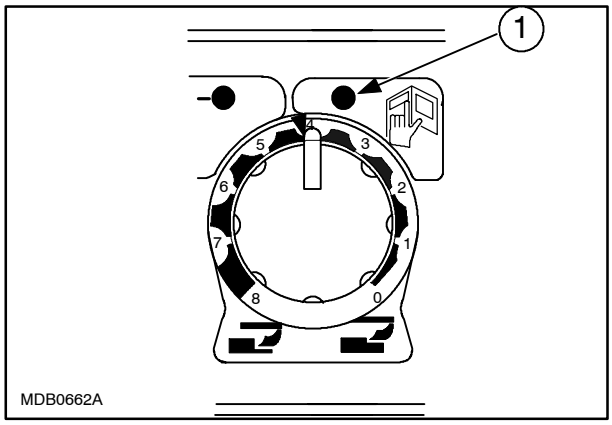
DESCRIPTION AND OPERATION

Lowering phase

The solenoid valve (1) overcomes the resistance of the relative spring and moves the actuator (4) inside the lowering valve (5). This allows the oil from chamber (6) to discharge through chamber (3), thereby decreasing the pressure inside chamber (5). In these conditions the oil pressure generated by the implement on the lifting cylinder, through the duct (7), will move the lowering valve (5) permitting the oil from the lifting cylinder to discharge through the chamber (3). The oil from pump (10) meets the closed lifting valve (11), therefore the full pump delivery will be discharged in chamber (9).

FAULT CODE INDICATION

If electrical or electronic faults occur, the illuminated indicator (1) underlines the fault code by means of a system of indicator flashes.



8

FAULT CODE DECODING

In order to read the fault code, close attention must be paid to the number of indicator flashes (1) and the order in which these flashes are transmitted.

In order to read the fault code transmitted by the control unit, proceed as follows:

1st phase: before transmitting the code, the control unit carries out a 2 second (approx.) pause;

2nd phase: after the pause, the first digit of the code is transmitted by means of a certain number of flashes in rapid succession;

3rd phase: after the transmission of the first digit, the control unit carries out another 2 second (approx.) pause;

4th phase: after the pause, the second digit of the code is transmitted by means of a certain number of flashes in rapid succession;

The control unit only indicates one code at a time, giving priority to the most serious faults.

In order to check whether other fault codes are in progress, the fault must be eliminated so that the control unit may pass on to the successive code.

IMPORTANT: *In the event of a fault that disables the lift controls, the corresponding code will be given priority over any other codes that were previously issued.*

- Example - Interpretation of fault code number 24 -

1st phase	2nd phase	3rd phase	4th phase
pause	●●	pause	●●●●
2s	first digit 2	1s	second digit 4
	fault code composition 24		

TROUBLESHOOTING

CAUTION

Notes to help the operator make diagnosis and problem–solving easier.

1. The measurements taken to read:
   voltage;
   resistance;
   frequency;
   must be carried out with a digital tester.

NOTE: *The resistance values shown are valid for a temperature of 68 °F (20 °C) (ambient temperature). With higher or lower tractor temperatures, the relative resistance values shown in the manual should vary accordingly.*

2. The “short to ground” message refers to a resistance value of less than 5 Ohm (Ω).

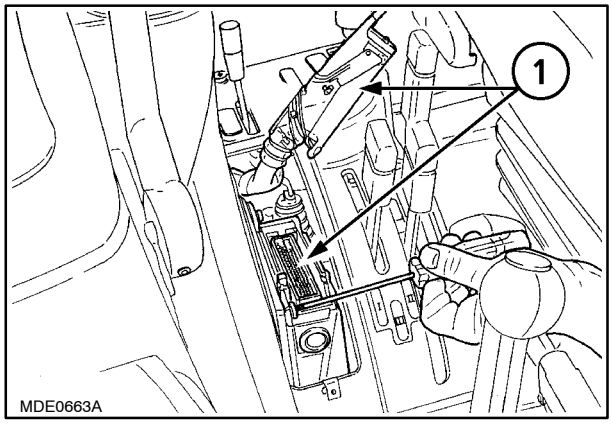
3. When a fault occurs, before carrying out any kind of service operations, check that the specific connections (control unit, sensors, switches, etc.) are correctly connected.
   A faulty connection could be the cause of incorrect tractor operation.

4. The connection references indicate: the wire dimension and colour, and the connection pin number.
   Example: 0.5 S (31)
   0.5 = wire dimension;
   S = wire colour;
   (31) = connection pin number.

5. The faults are listed in progressive order.

LOCATION OF THE ELECTRONIC CONTROL UNIT

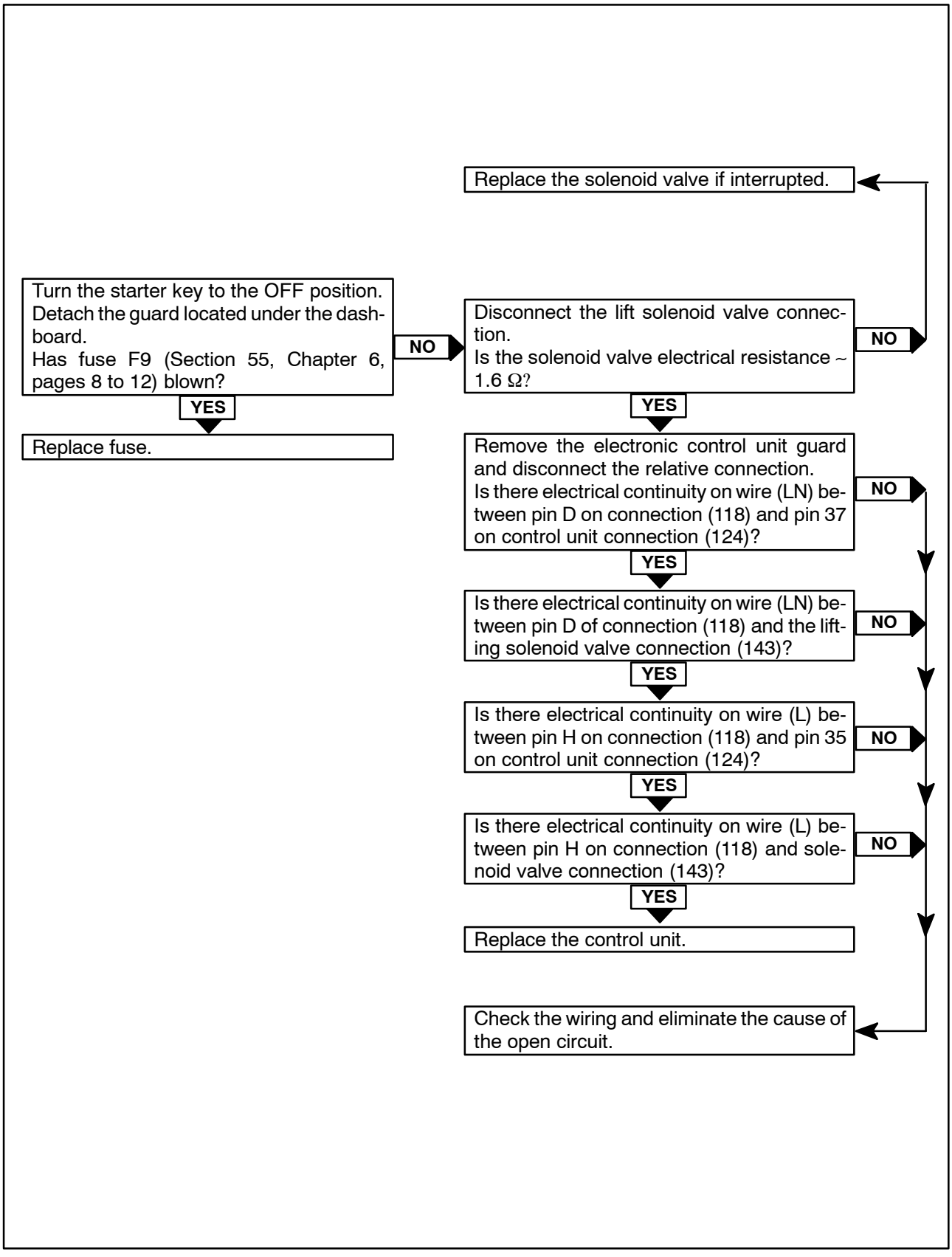
The electronic control unit (1) is located to the right of the driving seat and can be accessed by removing the protective cover.



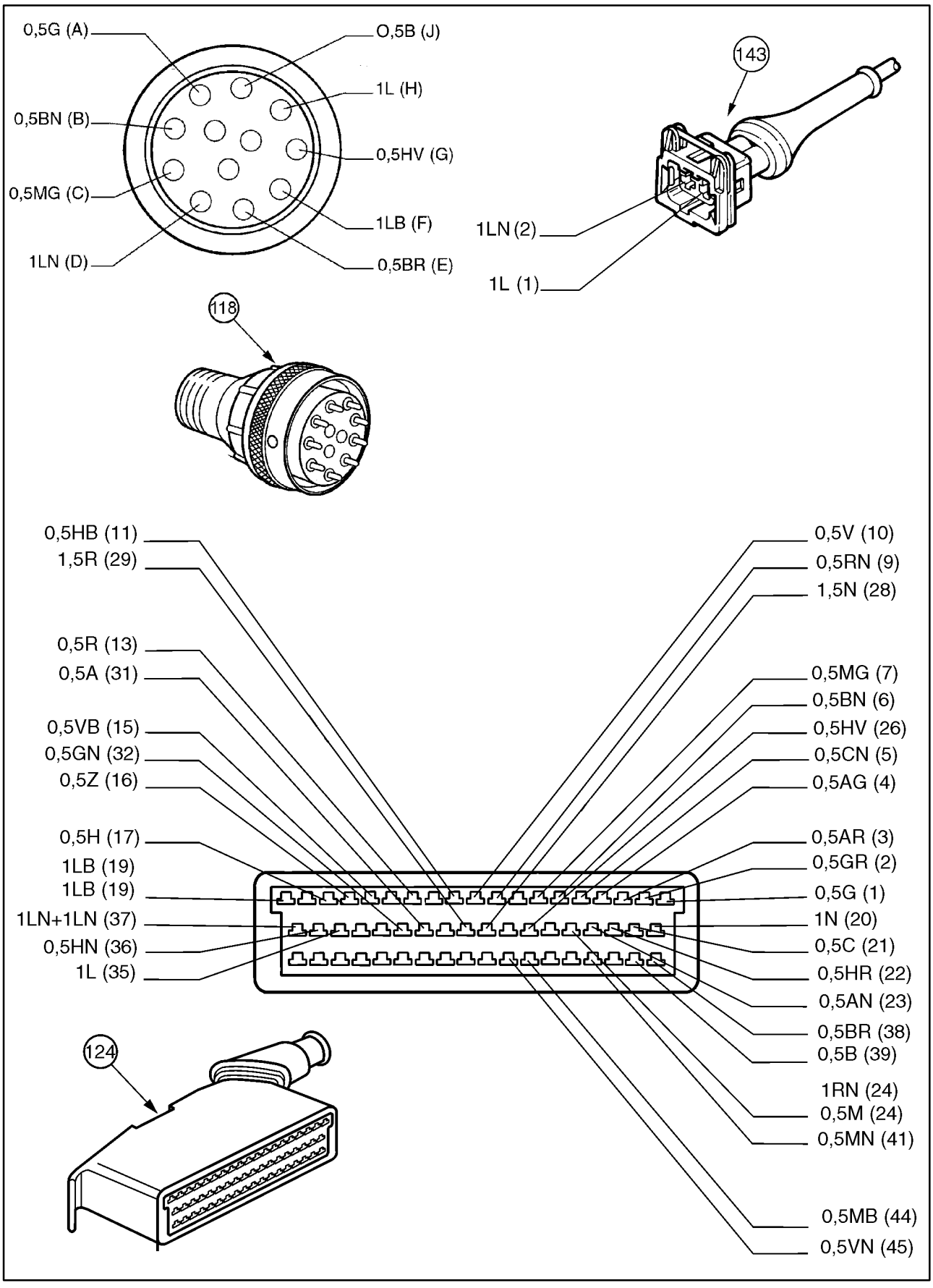
FAULT CODE 11

The lift control solenoid valve (143) is faulty or the relative circuit is open.

The rear lift does not work.



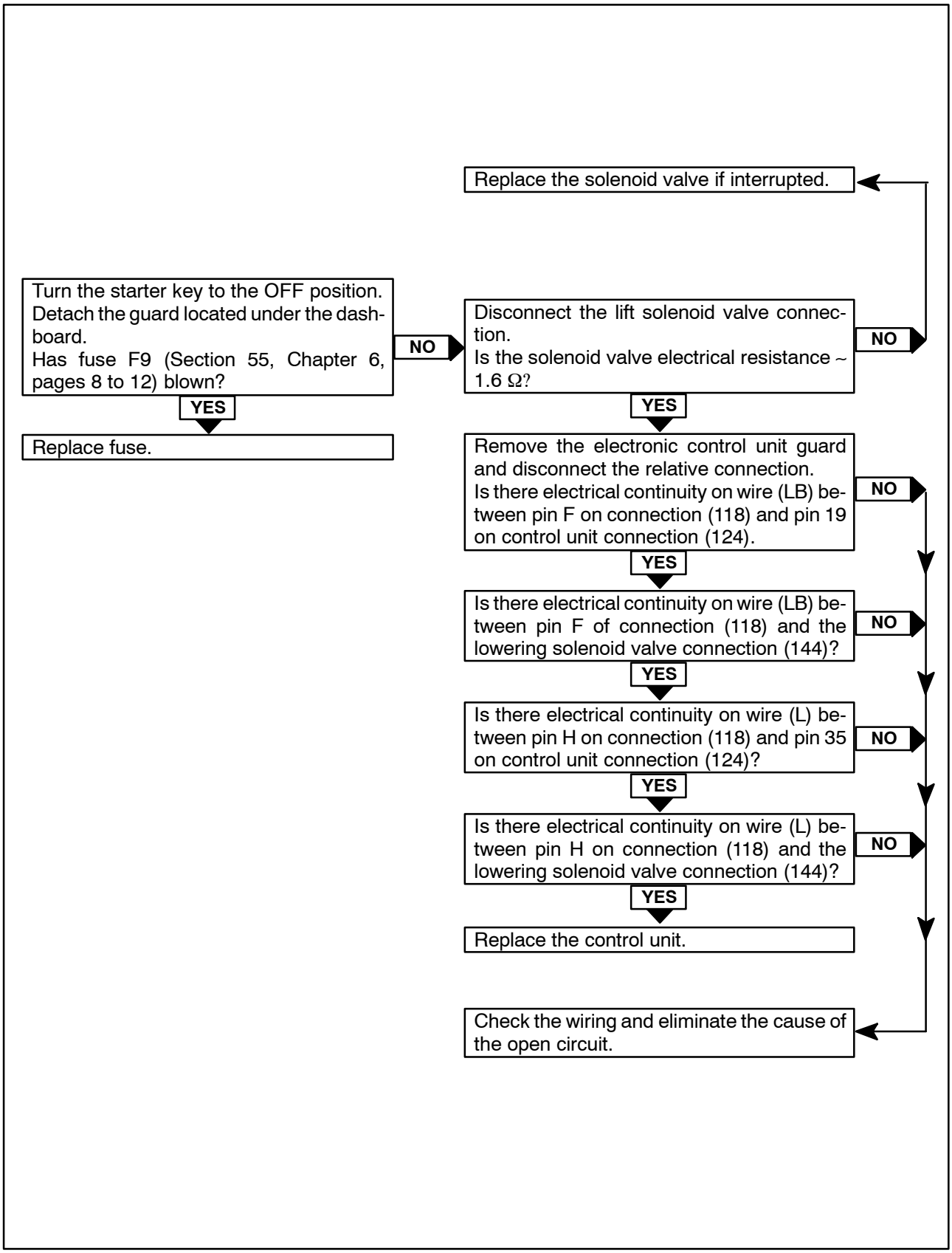
FAULT CODE 11



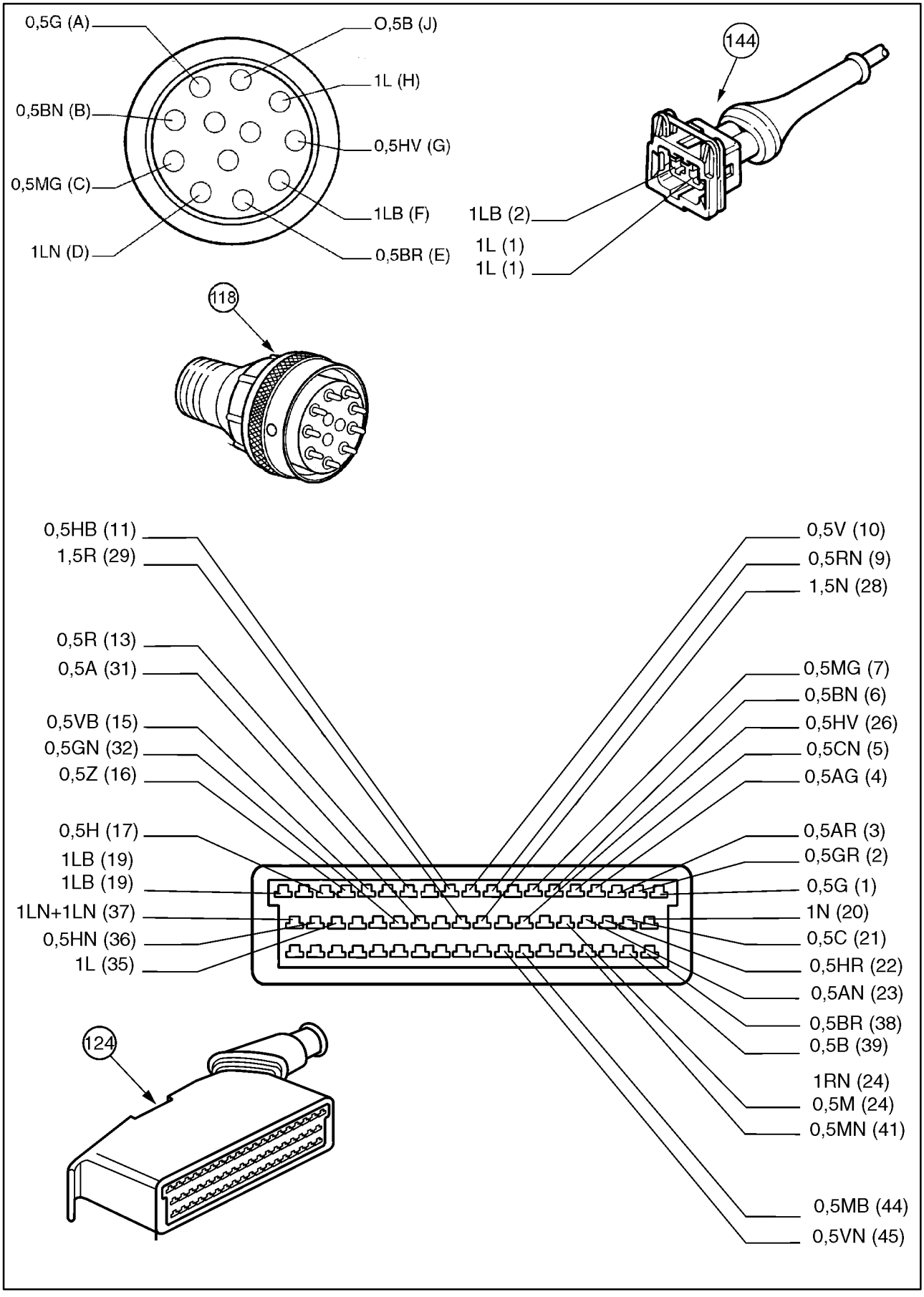
FAULT CODE 12

The lowering control solenoid valve (144) is faulty or the relative circuit is open.

The rear lift does not work.



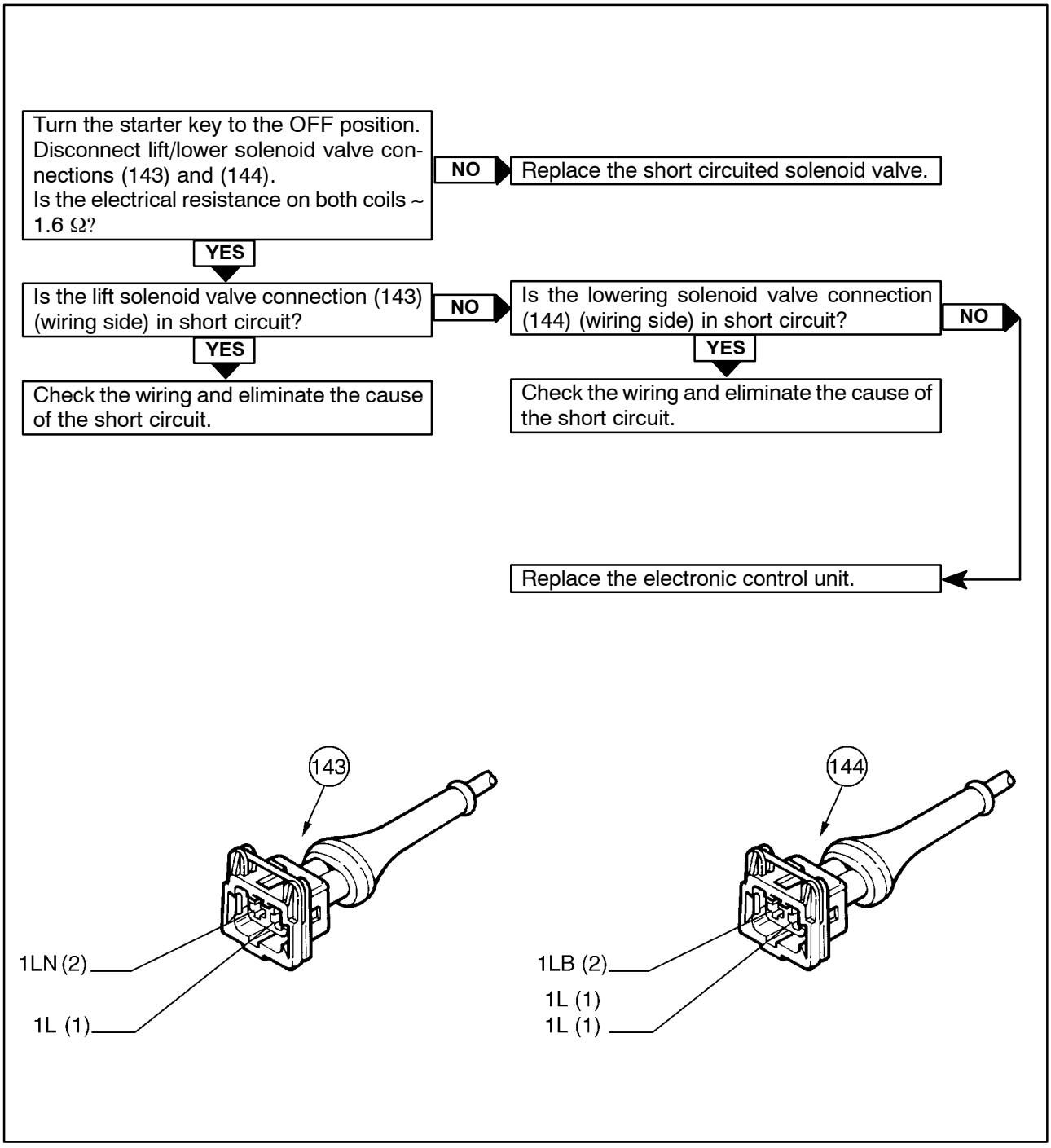
FAULT CODE 12



FAULT CODE 13

The lift/lower solenoid valves (144) and (143) are in short circuit.

The rear lift does not work.



FAULT CODE 14

The wiring on the lift/lower control solenoid valves (143) and (144) is disconnected or the solenoid valves are faulty.

The rear lift does not work.

Turn the starter key to the OFF position.
Disconnect lift/lower solenoid valve connections (143) and (144).
Is the electrical resistance on both solenoid valve coils ~ 1.6 Ω?

NO → Replace the faulty coil.

YES

Remove the electronic control unit guard and disconnect the relative connection (124).
Is there electrical continuity on wire (LN) on lift solenoid valve connection (143), pin D on connection (118) and pin 37 on control unit connection (124)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

Is there electrical continuity on wire (L) on solenoid valve connections (143) and (144), pin H on connection (118) and pin 35 on control unit connection (124)?

NO → Check the wiring and eliminate the cause of the open circuit.

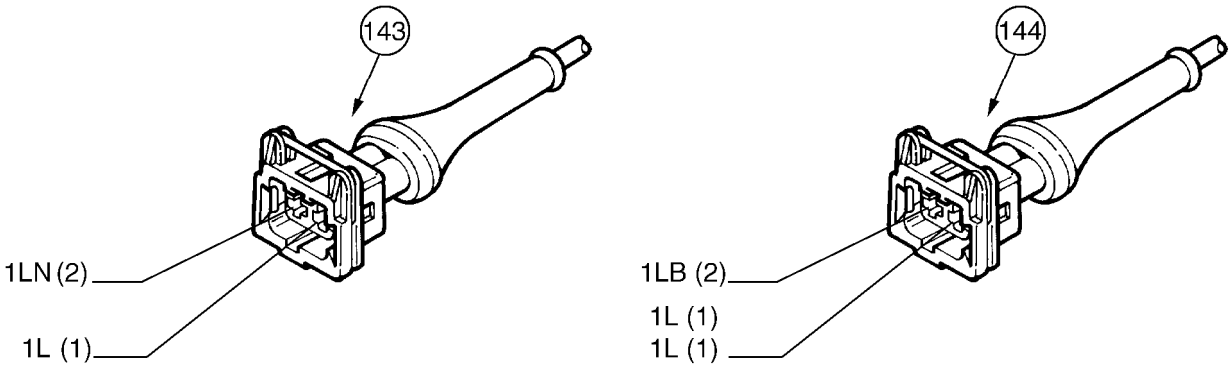
YES

Is there electrical continuity on wire (LB) on lowering solenoid valve connection (144), pin F on connection (118) and pin 19 on control unit connection (124)?

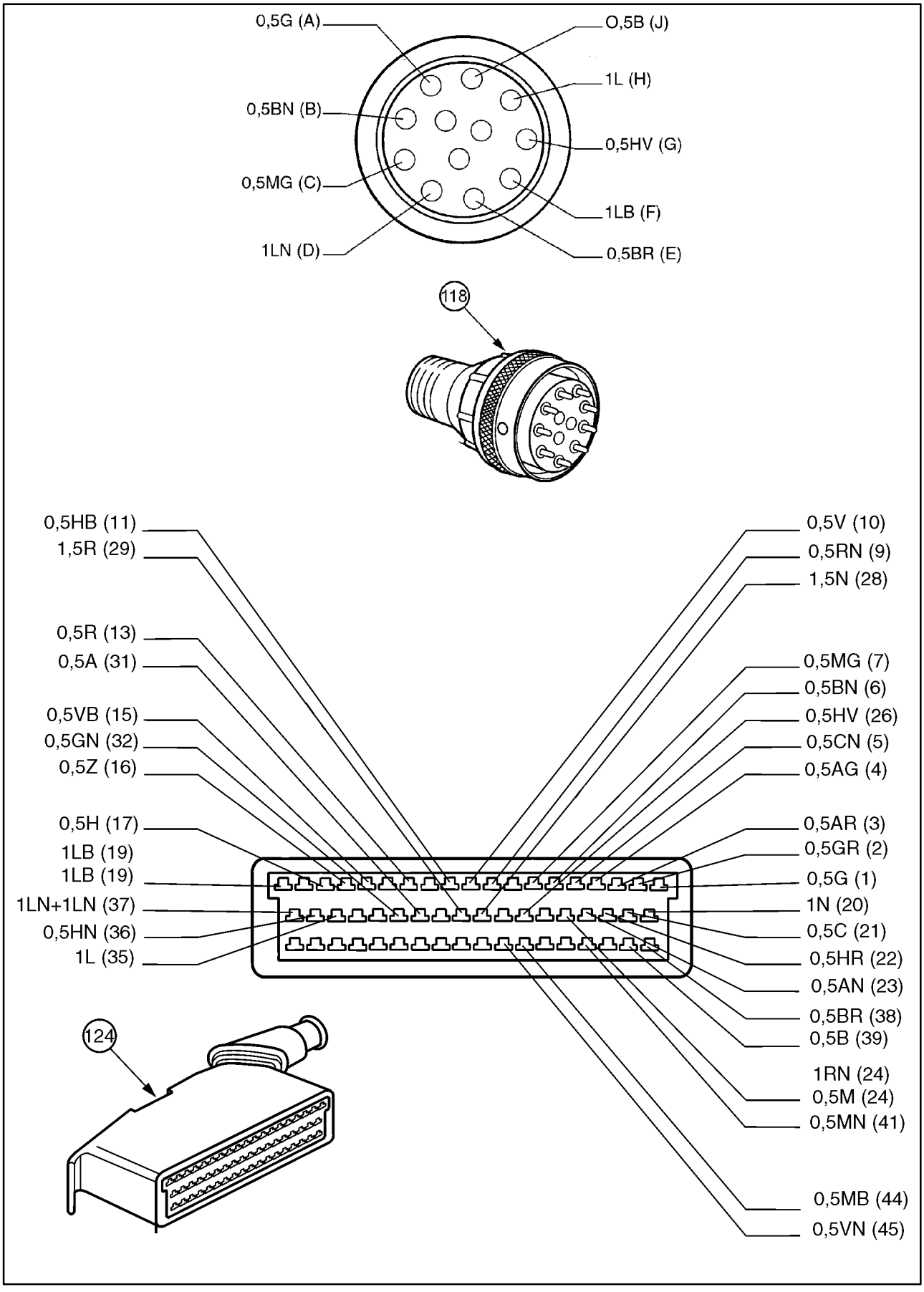
NO → Check the wiring and eliminate the cause of the open circuit.

YES

Replace the electronic control unit.



FAULT CODE 14



FAULT CODE 15

The wires on lift control external switches (121) and (122) are in short circuit to ground.
The rear lift does not work.

Turn the starter key to the OFF position.
Disconnect both connections on external switches (121) and (122).
Is wire (HN) on the left-hand switch (122) in short circuit to ground?

NO → Is wire (RN) on the external switches in short circuit to ground?

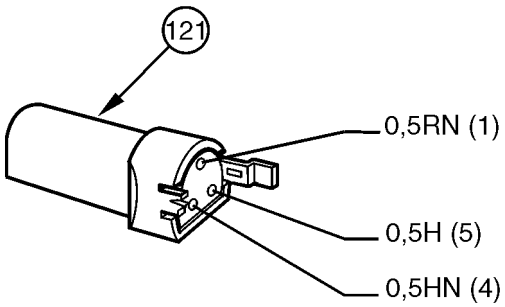
NO → Is wire (H) on the external switches in short circuit to ground?

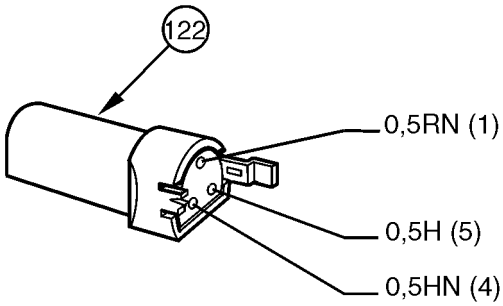
NO → Replace the electronic control unit.

YES → Eliminate the cause of the short circuit to ground between the external switches connections (121) and (122) and pin 17 on control unit connection (124).

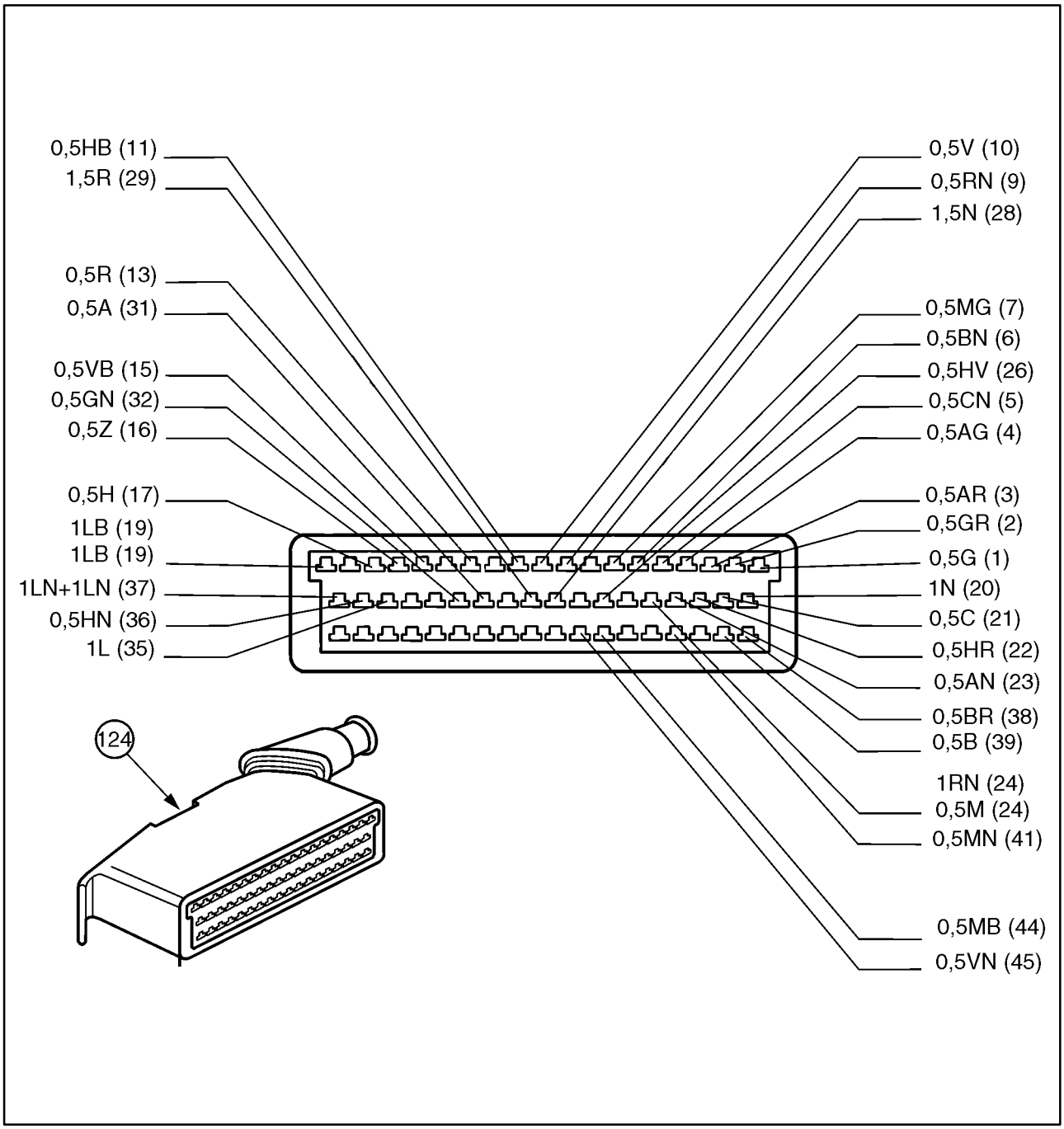
YES → Eliminate the cause of the short circuit to ground between the external switches connections (121) and (122) and pin 9 on control unit connection (124).

YES → Remove the electronic control unit guard and disconnect the relative connection (124).
Eliminate the cause of the short circuit to ground between switch connection (122) and pin 36 on control unit connection (124).





FAULT CODE 15



FAULT CODE 16

The lift control panel power supply voltage (114) is low < 9.5 V.

The rear lift does not work.

Turn the starter key to the OFF position.
Remove the electronic control unit guard and disconnect the relative connection (124).
Is the ground connection on wire (N) between pin 6 on lift control panel connection (114) and pin 20 on control unit connection (124) correct?

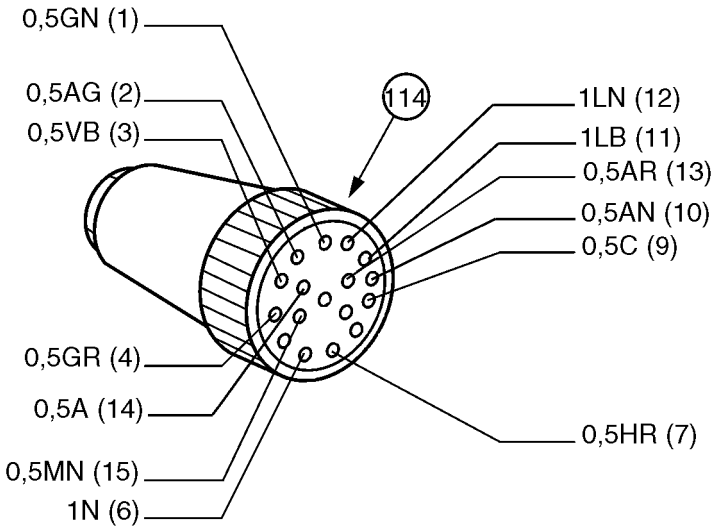
NO → Connect the ground connection correctly.

YES

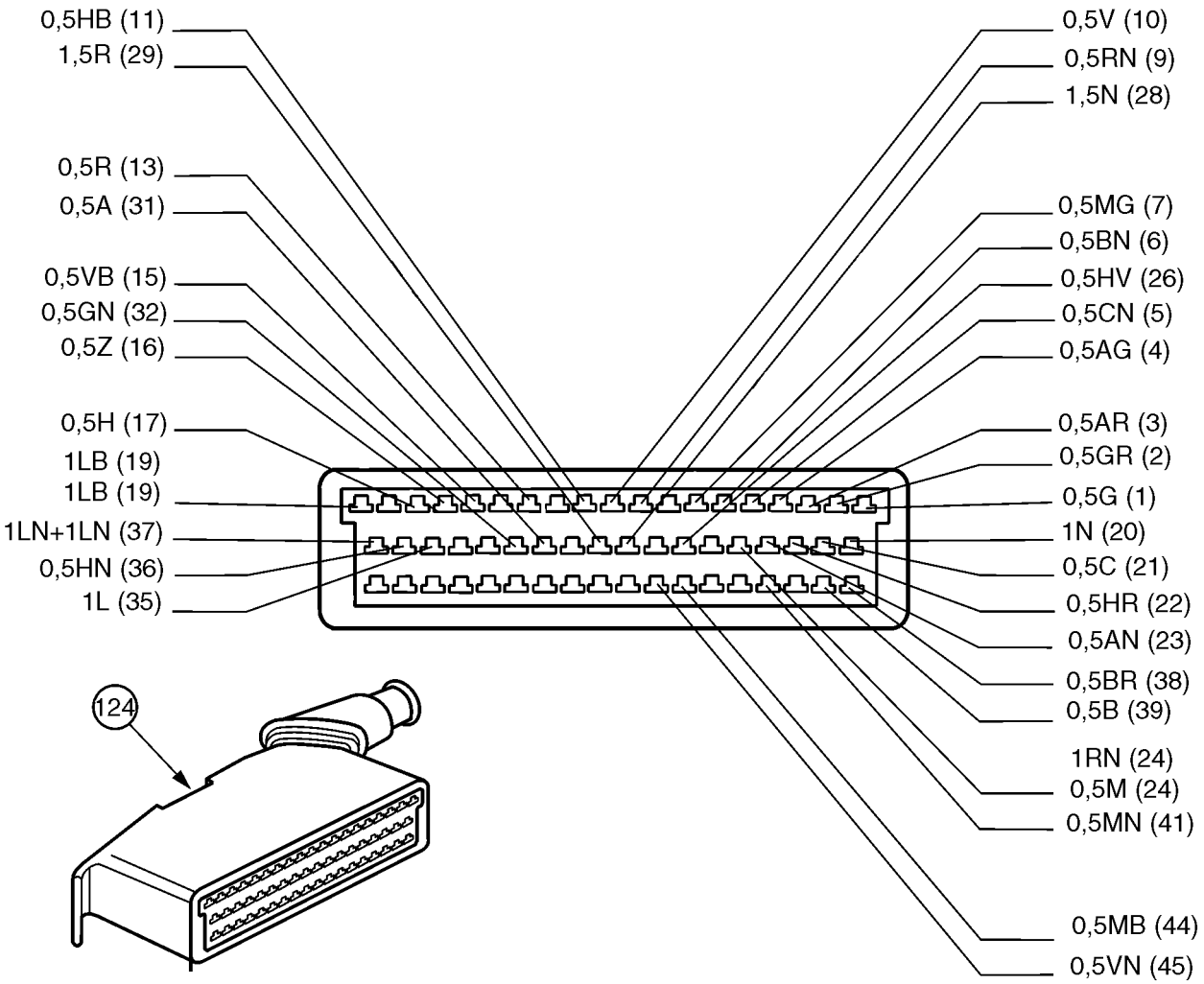
Replace the electronic control unit.
Does the fault persist?

YES

Replace the lift control panel.



FAULT CODE 16



FAULT CODE 17

The supply voltage on the electronic control unit (1) is > 18V.

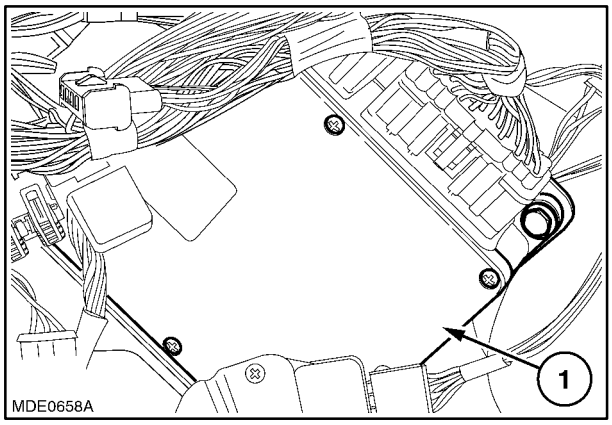
The rear lift does not work.

Start the engine and, using a digital tester, check the battery charge voltage.
Is the voltage reading > 18V?

NO → Replace the electronic control unit (1).

YES

Repair the recharging system.



FAULT CODE 18

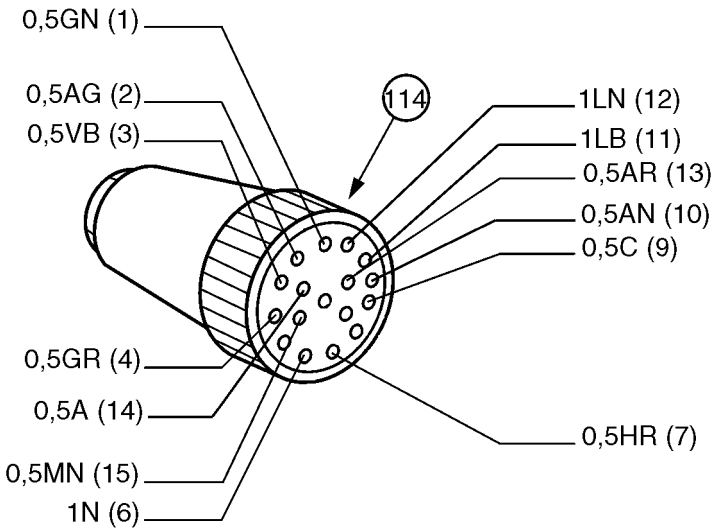
The lift-lower control lever of the lift control panel (114) is faulty.

The rear lift does not work.

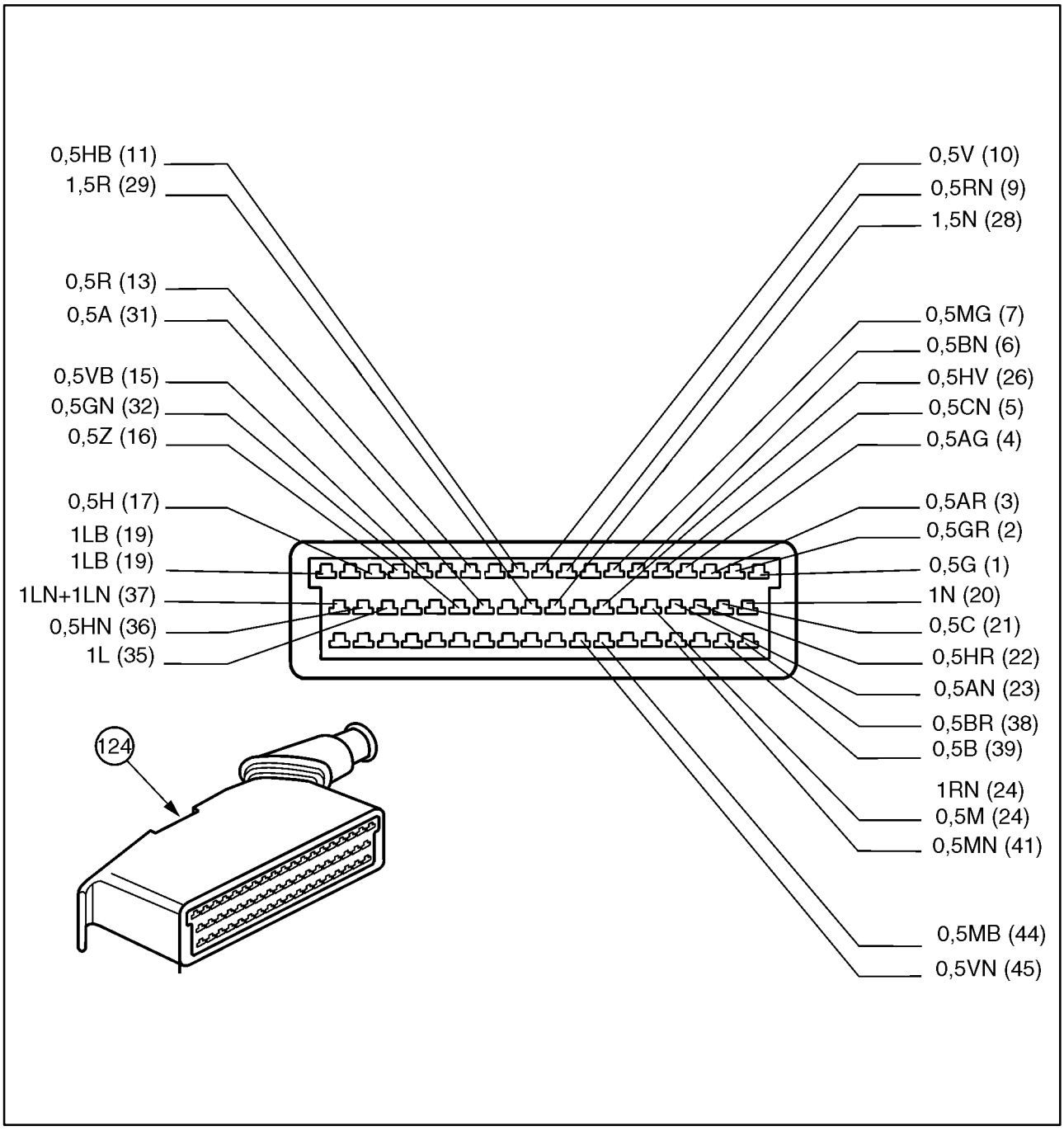
Turn the starter key to the OFF position.
Remove the electronic control unit guard and disconnect the relative connection (124).
Is there electrical continuity on wire (C) between pin 21 on control unit connection (124) and pin 9 on control panel connection (114)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES → Replace the lift control panel.



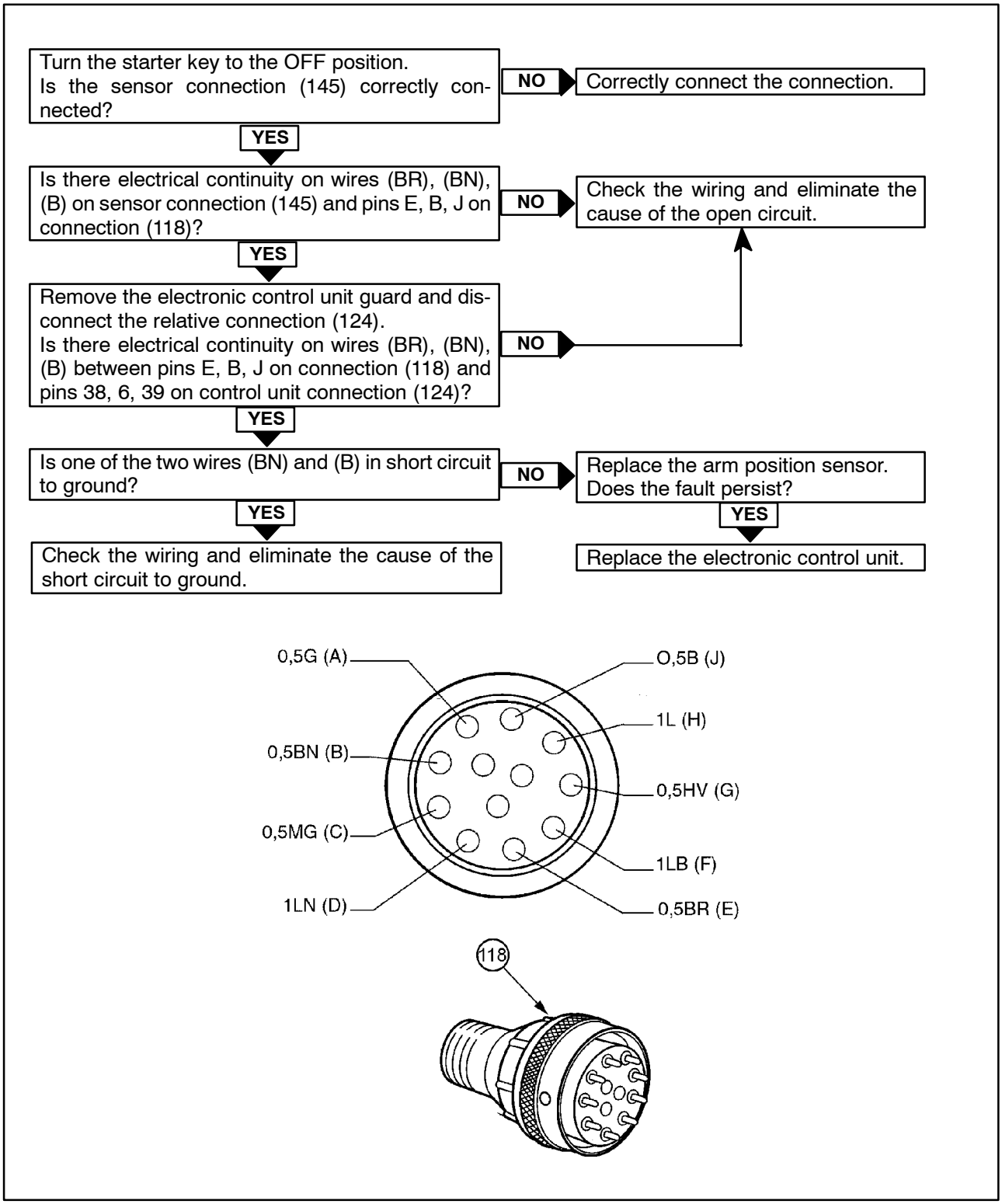
FAULT CODE 18



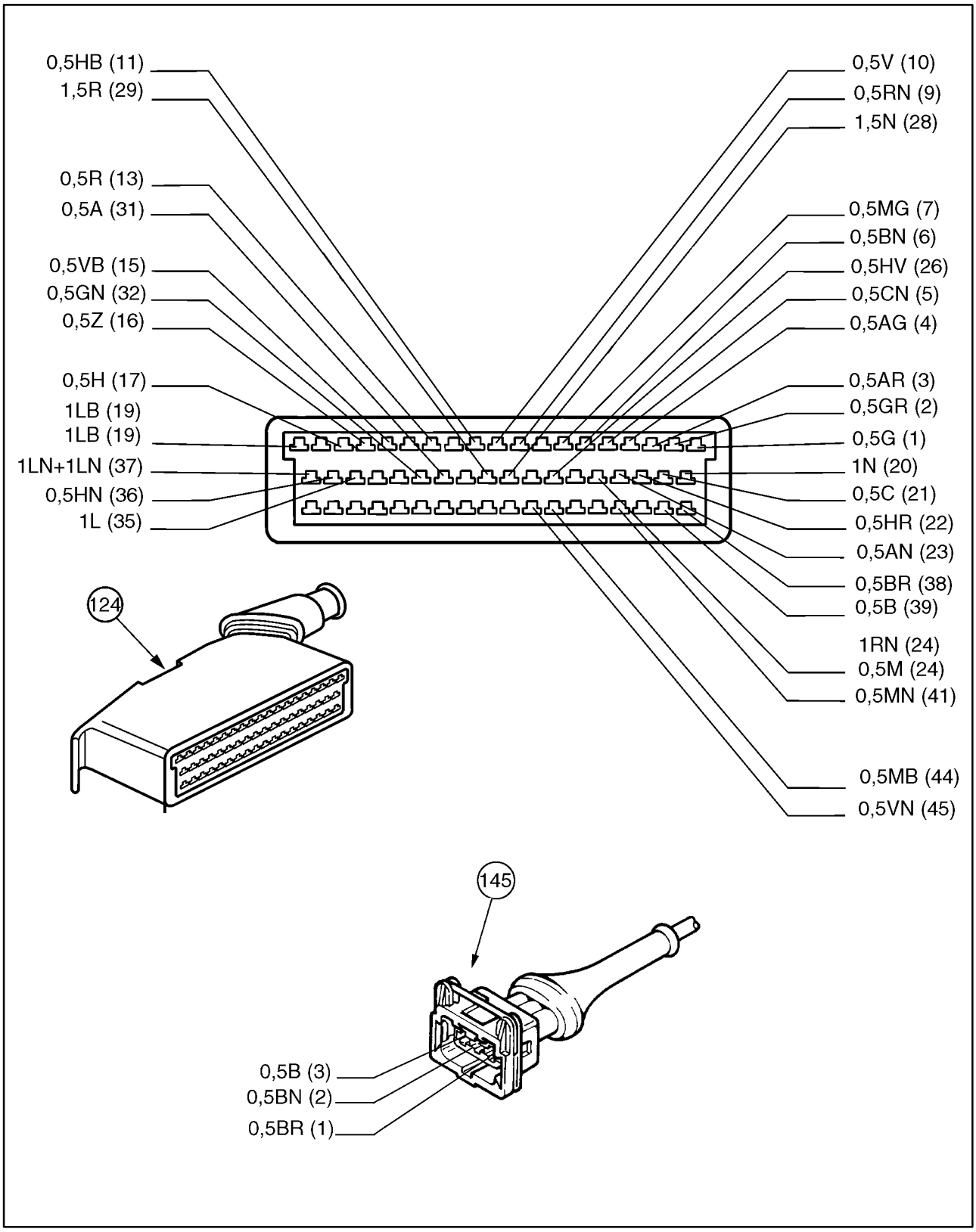
FAULT CODE 22

The wiring on the lift arms position sensor (145) is disconnected, interrupted, in short circuit to ground or the sensor is faulty.

The rear lift does not work.



FAULT CODE 22



FAULT CODE 23

The working depth adjustment potentiometer is faulty.

The rear lift does not work.

Turn the starter key to the OFF position.
Remove the electronic control unit guard and disconnect the relative connection (124).
Is there electrical continuity on wire (HR) between pin 7 on lift control panel connection (114) and pin 22 on control unit connection (124)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

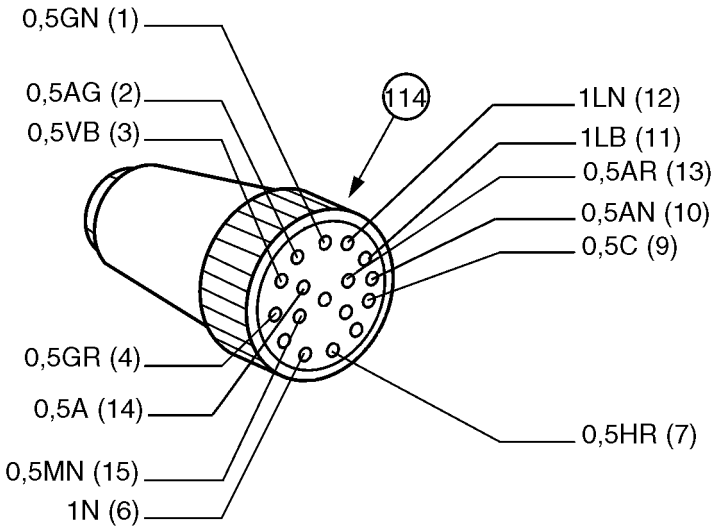
Is wire (HR) in short circuit to ground?

NO → Replace the control panel.
Does the fault persist?

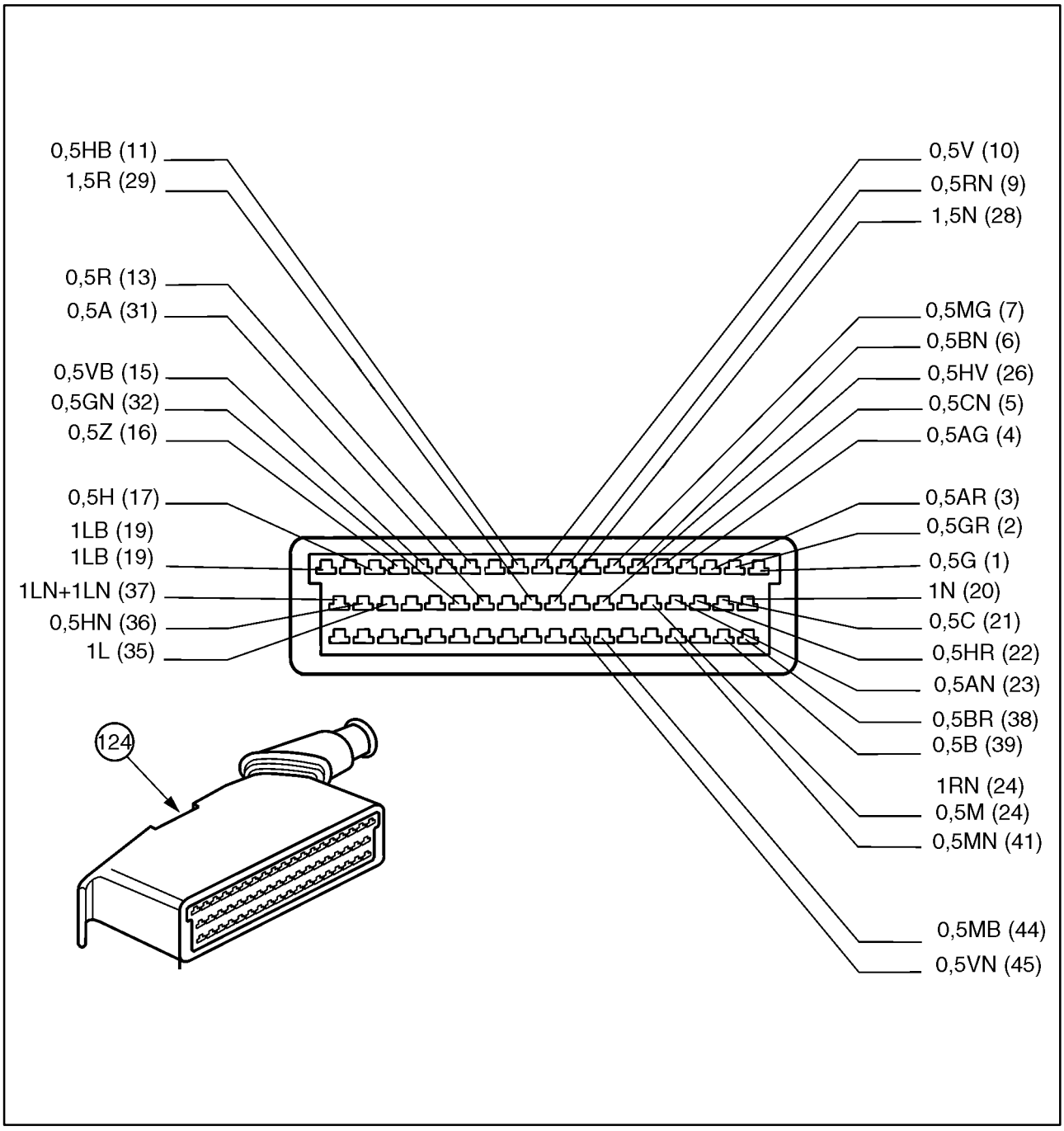
YES → Replace the electronic control unit.

YES

Check the wiring and eliminate the cause of the short to ground.



FAULT CODE 23



FAULT CODE 24

The lift arms upper limit adjustment potentiometer is faulty.

The rear lift does not work.

Turn the starter key to the OFF position.
Remove the electronic control unit guard and disconnect the relative connection (124).
Is there electrical continuity on wire (AR) between pin 13 on lift control panel connection (114) and pin 3 on control unit connection (124)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

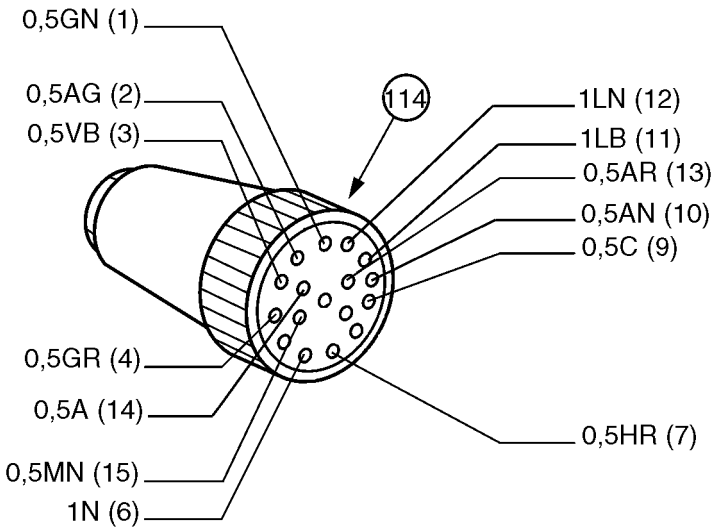
Is wire (AR) in short to ground?

NO → Replace the control panel.
Does the fault persist?

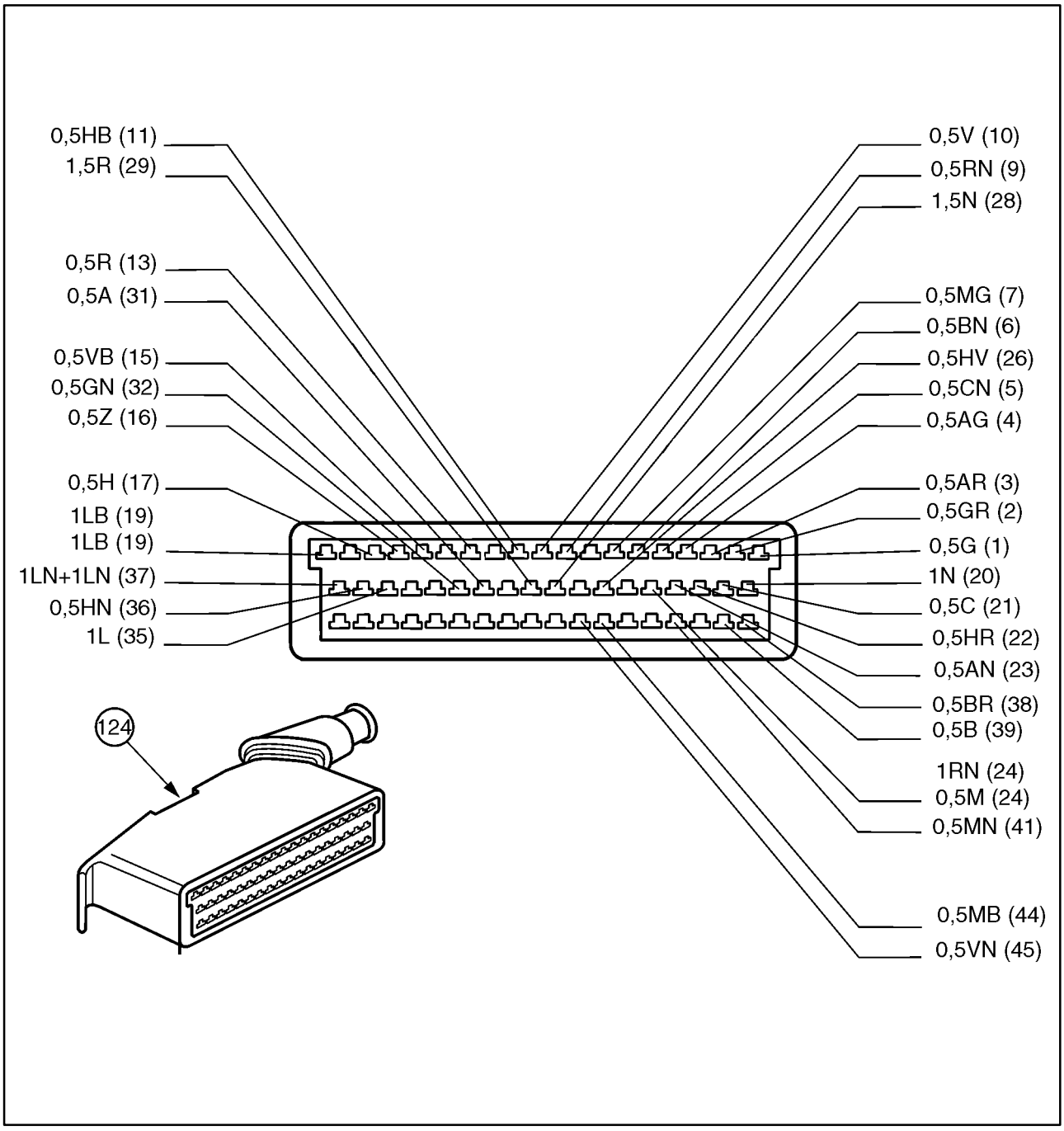
YES → Replace the electronic control unit.

YES

Check the wiring and eliminate the cause of the short to ground.



FAULT CODE 24



FAULT CODE 31

The draft right-hand sensor connection (119) is disconnected, or the wiring is interrupted, or in short circuit to ground, or the sensor is faulty.

The lift works but in controlled draft selection operation is not correct.

Check the wiring and eliminate the cause of the open circuit.

Turn the starter key to the OFF position. Is draft sensor connection (119) connected?

NO → Connect the connection.

YES

Disconnect sensor connection (119), is wire (HV) on pin 2 on sensor connection (119) in short circuit to ground?

NO → Is there electrical continuity on wire (HV) between pin 2 on sensor connection (119) and pin G on connection (118)?

NO

YES

Check the wiring and eliminate the cause of the short circuit.

YES

Remove the electronic control unit guard and disconnect the relative connection (124).
Is there electrical continuity on wire (HV) between pin G on connection (118) and pin 26 on control unit connection (124)?

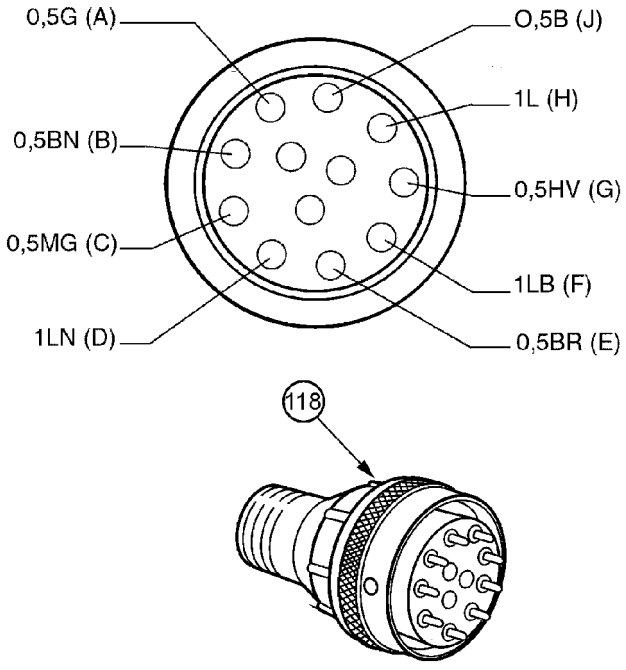
NO

YES

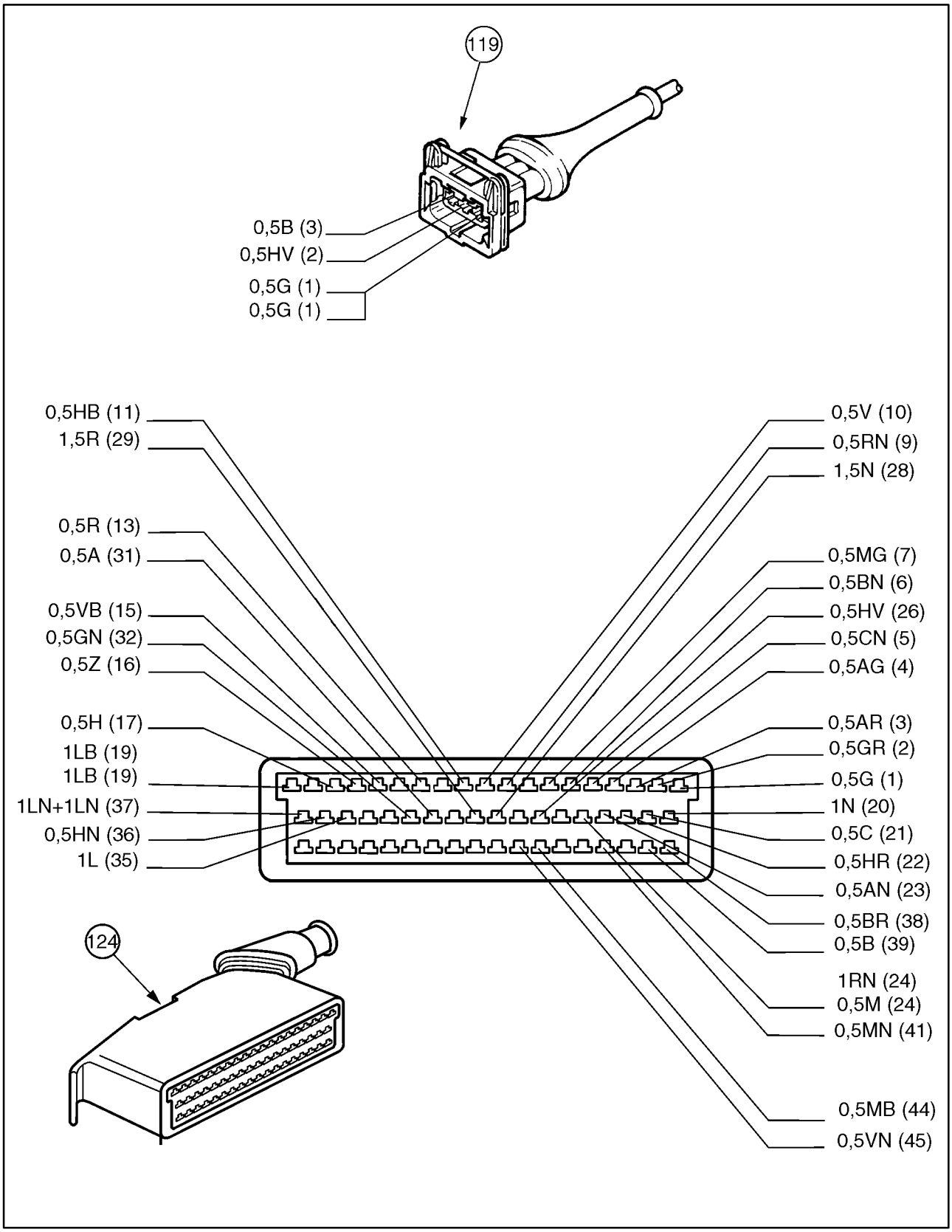
Replace the draft sensor.
Does the fault persist?

YES

Replace the electronic control unit.



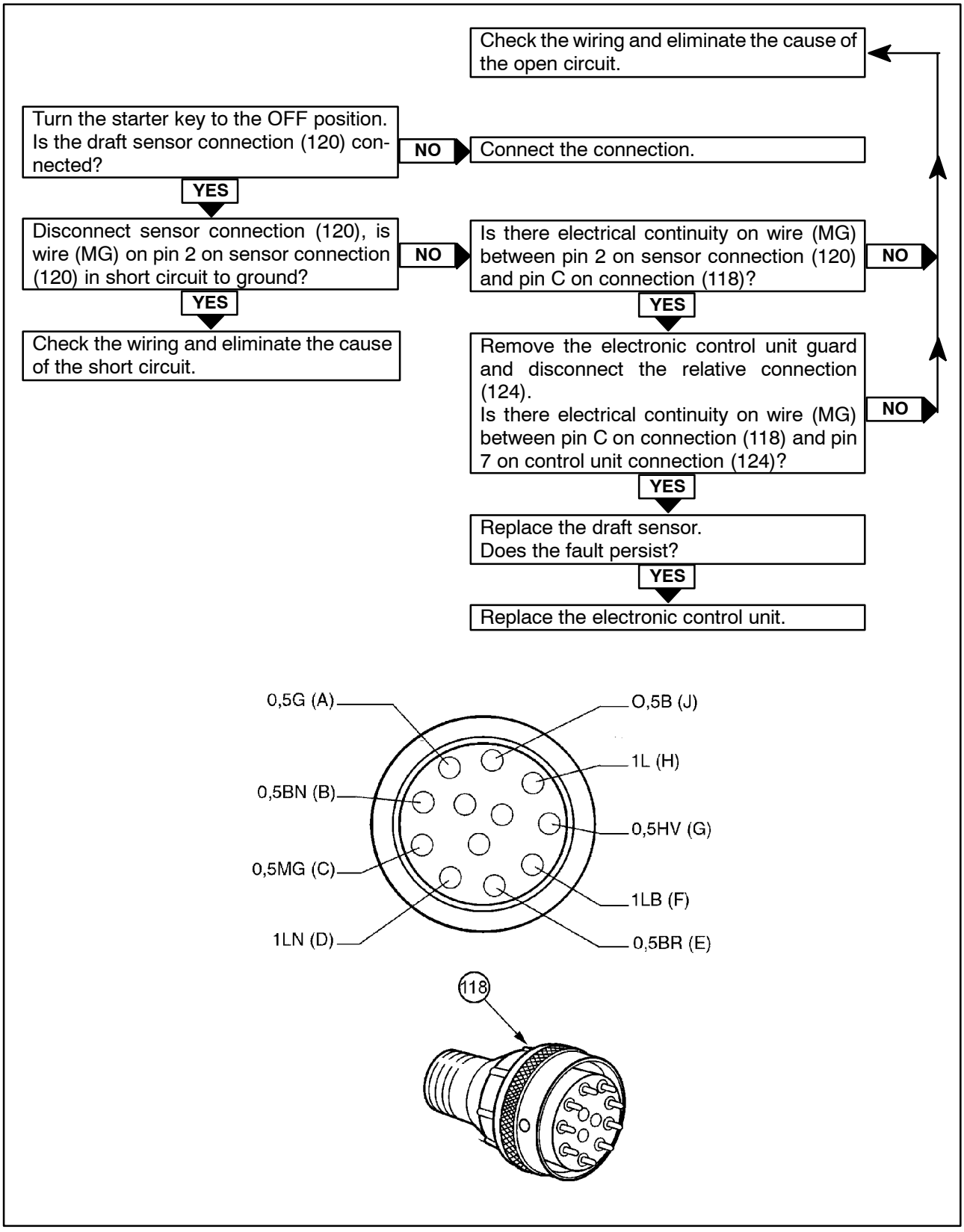
FAULT CODE 31



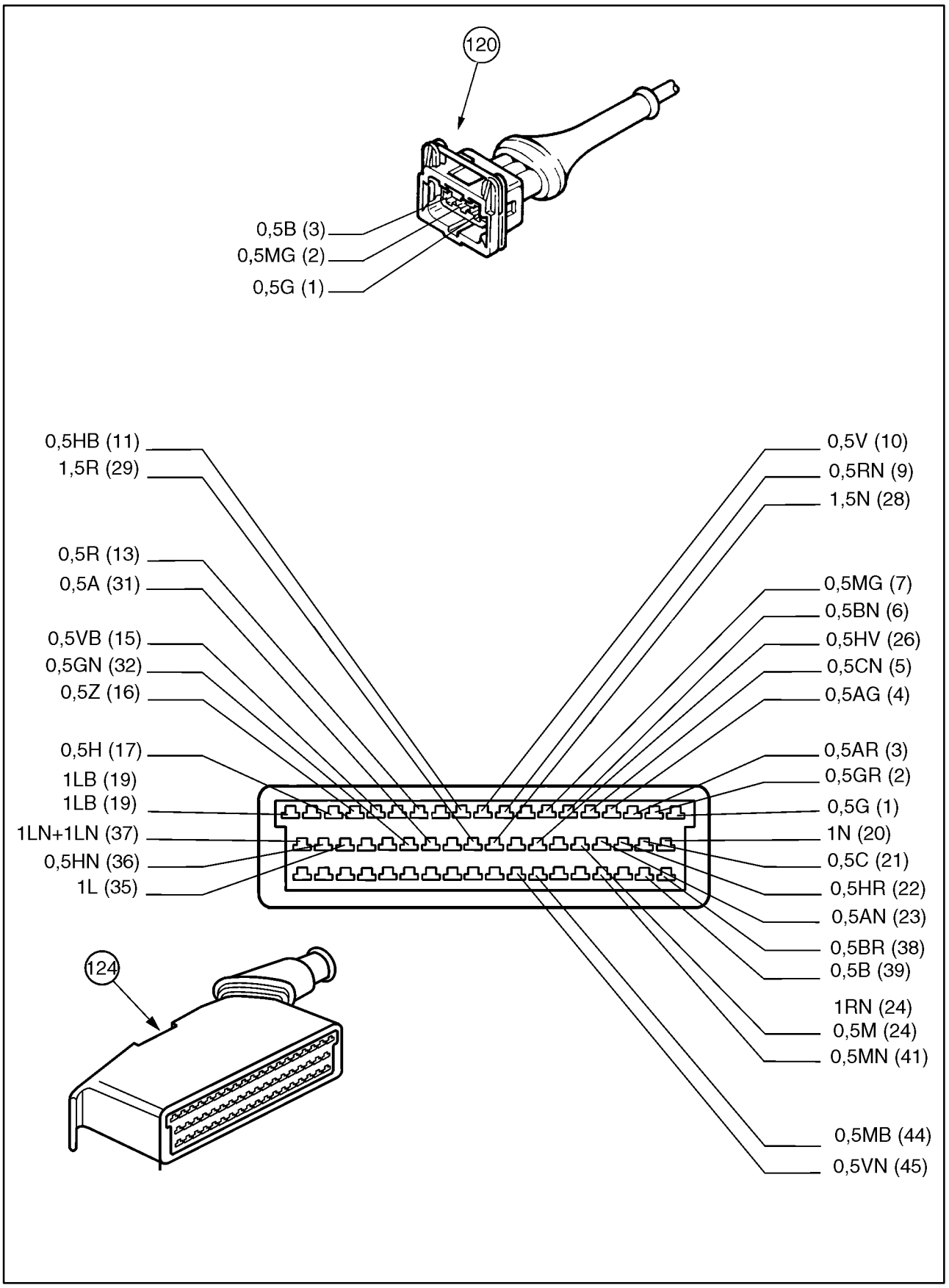
FAULT CODE 32

The draft left-hand sensor connection (120) is disconnected or the wiring is interrupted, or in short circuit to ground, or the sensor is faulty.

The lift works but in controlled draft selection operation is not correct.



FAULT CODE 32



FAULT CODE 34

The lift arms descent speed adjustment potentiometer is faulty.

The rear lift works but the arm descent speed cannot be adjusted.

Turn the starter key to the OFF position.
Remove the electronic control unit guard and disconnect the relative connection (124).
Is there electrical continuity on wire (AN) between pin 10 on lift control panel connection (114) and pin 23 on control unit connection (124)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES ↓

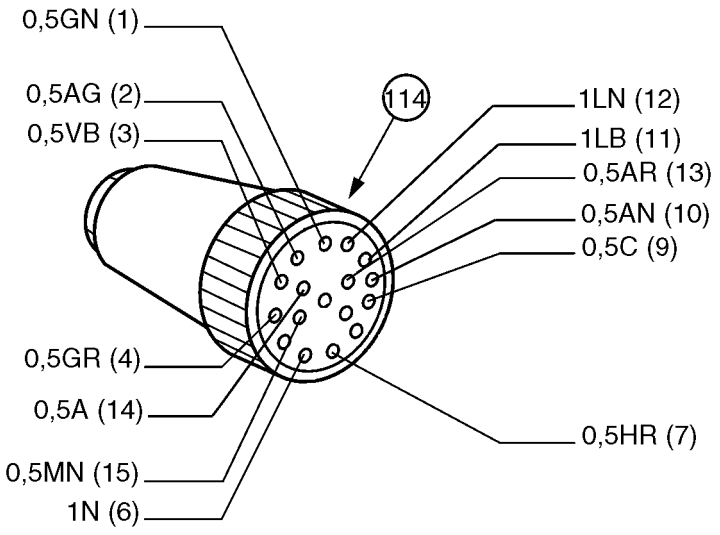
Is wire (AN) in short circuit to ground?

NO → Replace the control panel.
Does the fault persist?

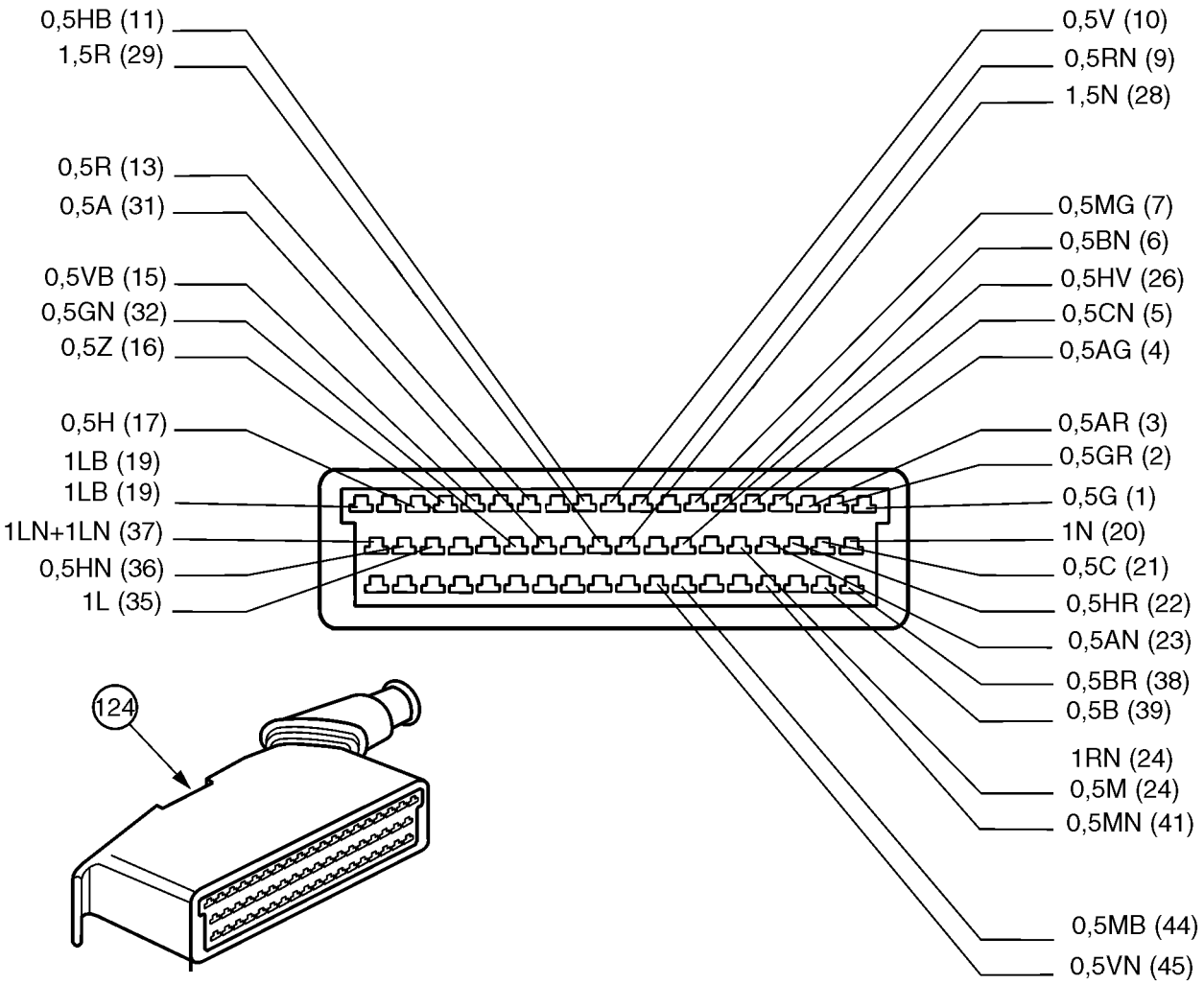
YES → Replace the electronic control unit.

YES ↓

Check the wiring and eliminate the cause of the short to ground.



FAULT CODE 34



FAULT CODE 36

The position/draft mix potentiometer is faulty.

The rear lift works only to raise and lower.

Turn the starter key to the OFF position.
Remove the electronic control unit guard and disconnect the relative connection (124).
Is there electrical continuity on wire (AG) between pin 2 on lift control panel connection (114) and pin 4 on control unit connection (124)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES

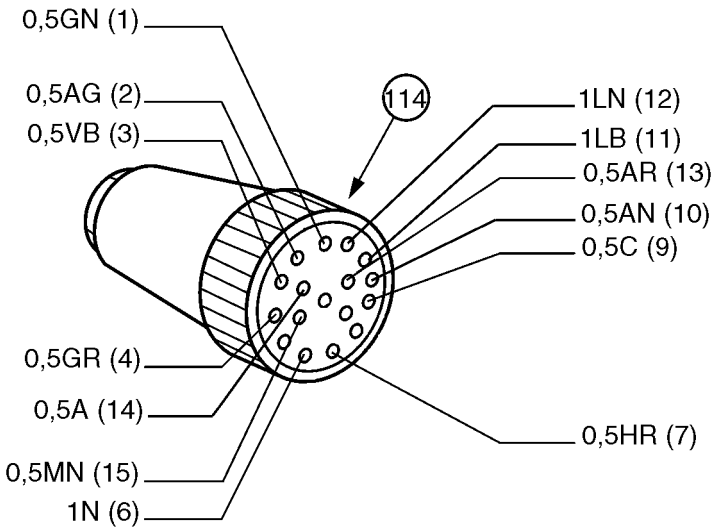
Is wire (AG) in short to ground?

NO → Replace the control panel.
Does the fault persist?

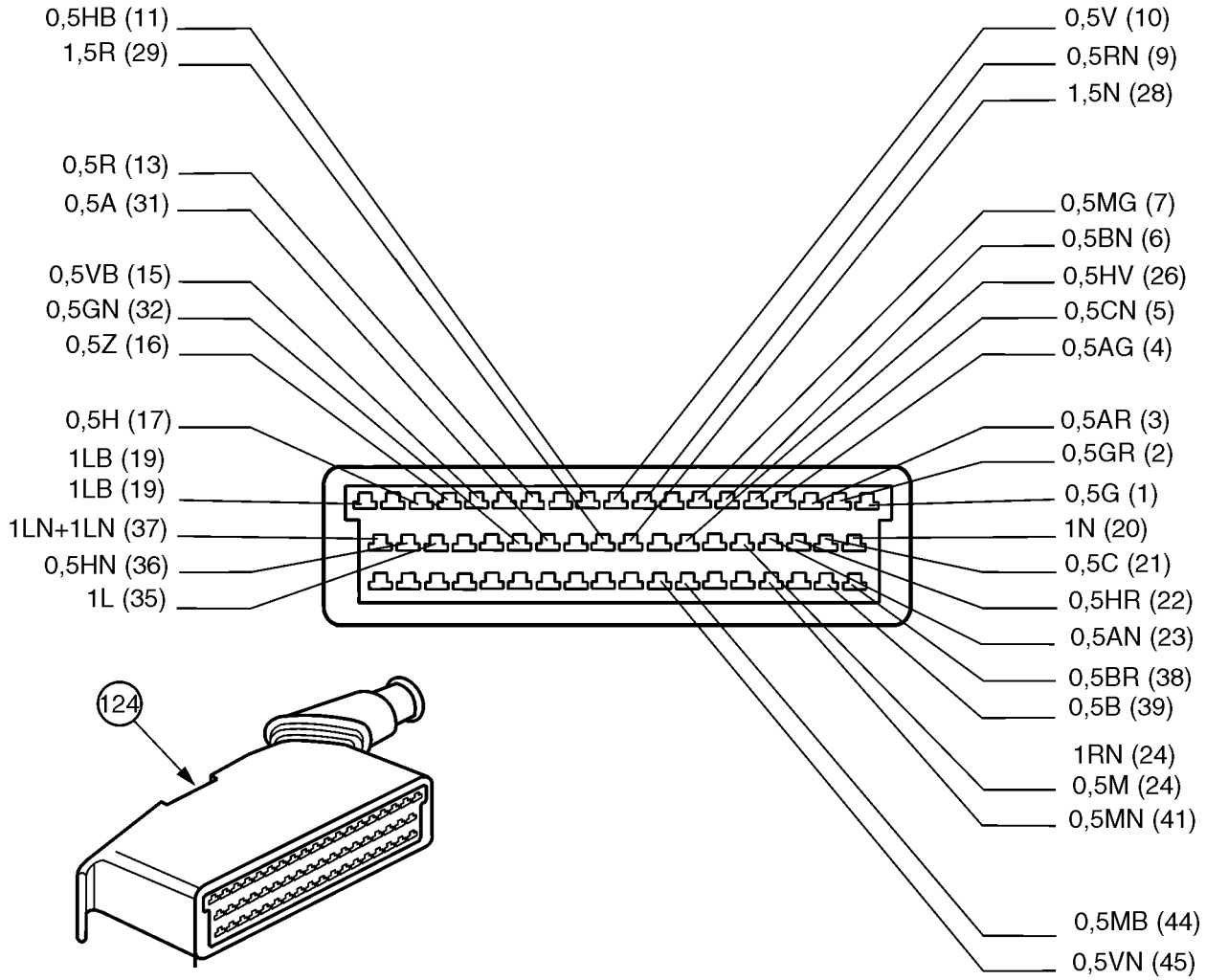
YES → Replace the electronic control unit.

YES

Check the wiring and eliminate the cause of the short to ground.



FAULT CODE 36



FAULT CODE 37

The lift does not raise, although solenoid valves (143) and (144) are correctly powered.
The rear lift does not work.

Turn the starter key to the OFF position. Disconnect the solenoid valve connections (143) and (144), remove the caps on the solenoid valves and press the pin, does the lift work?

NO → Check the hydraulic system and replace any faulty parts.

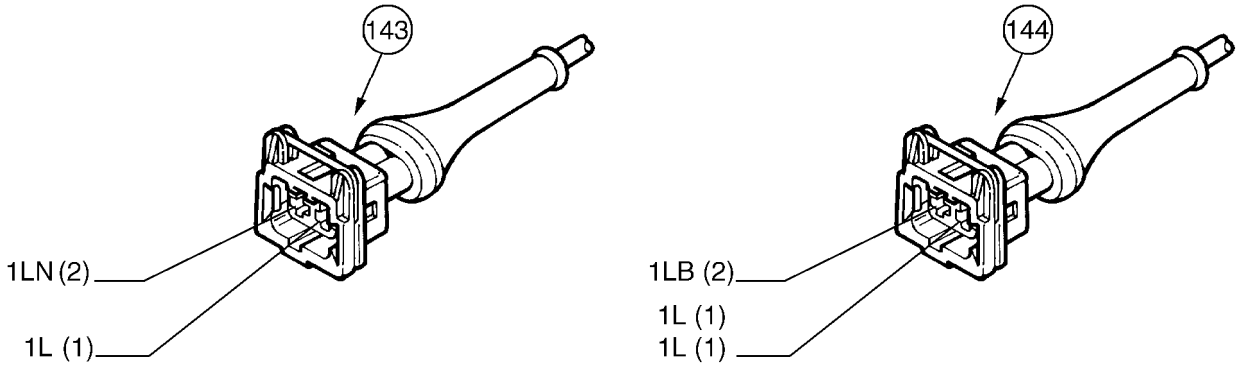
YES

Is the lift arm position potentiometer mechanically connected to the arms?

NO → Connect the potentiometer to the lift arms.

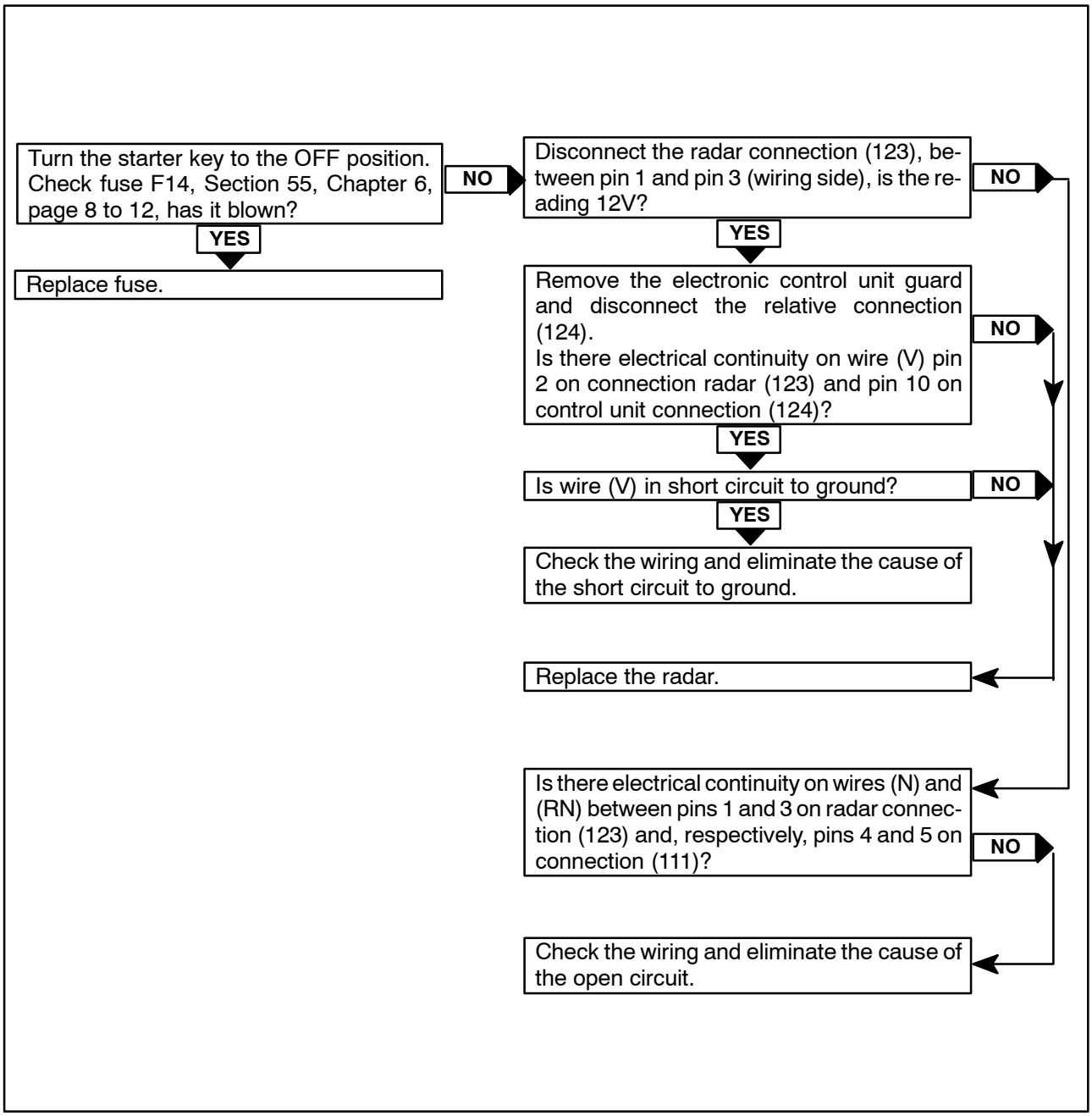
YES

Replace the potentiometer.

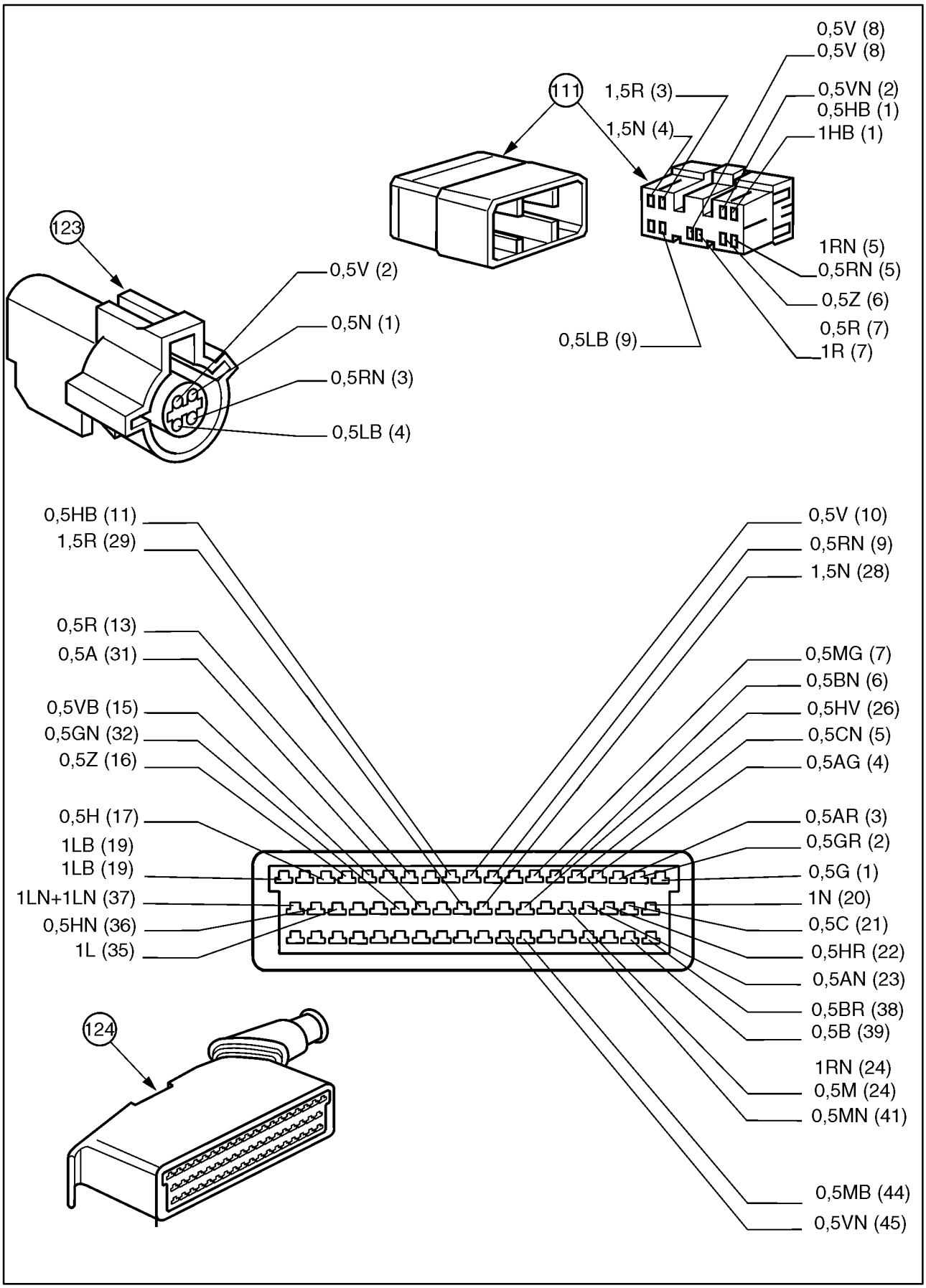


FAULT CODE 41

The radar signal (123) is not present. The fault can only be seen if the slip control is in the ON position. The lift works but slip control is not activated.



FAULT CODE 41



FAULT CODE 42

The speed signal from sensor (68) on the transmission is not present. The fault can only be seen if the slip control is in the ON position.

The lift works but slip control is not activated.

Turn the starter key to the OFF position.
Disconnect the control panel.
Disconnect connection (111), between male pins 1 (HB) and 2 (VN) (transmission side), is the reading ~ 500 Ω?

NO → Is there electrical continuity on wires (HB) and (VN) and the speed sensor connection (68)?

NO → Replace the speed sensor.

YES → Are the two wires (HB) and (VN) in short circuit?

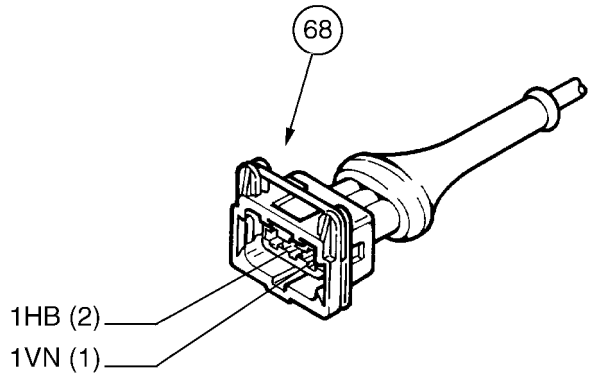
NO → Replace the speed sensor.

YES → Check the wiring and eliminate the cause of the short circuit.

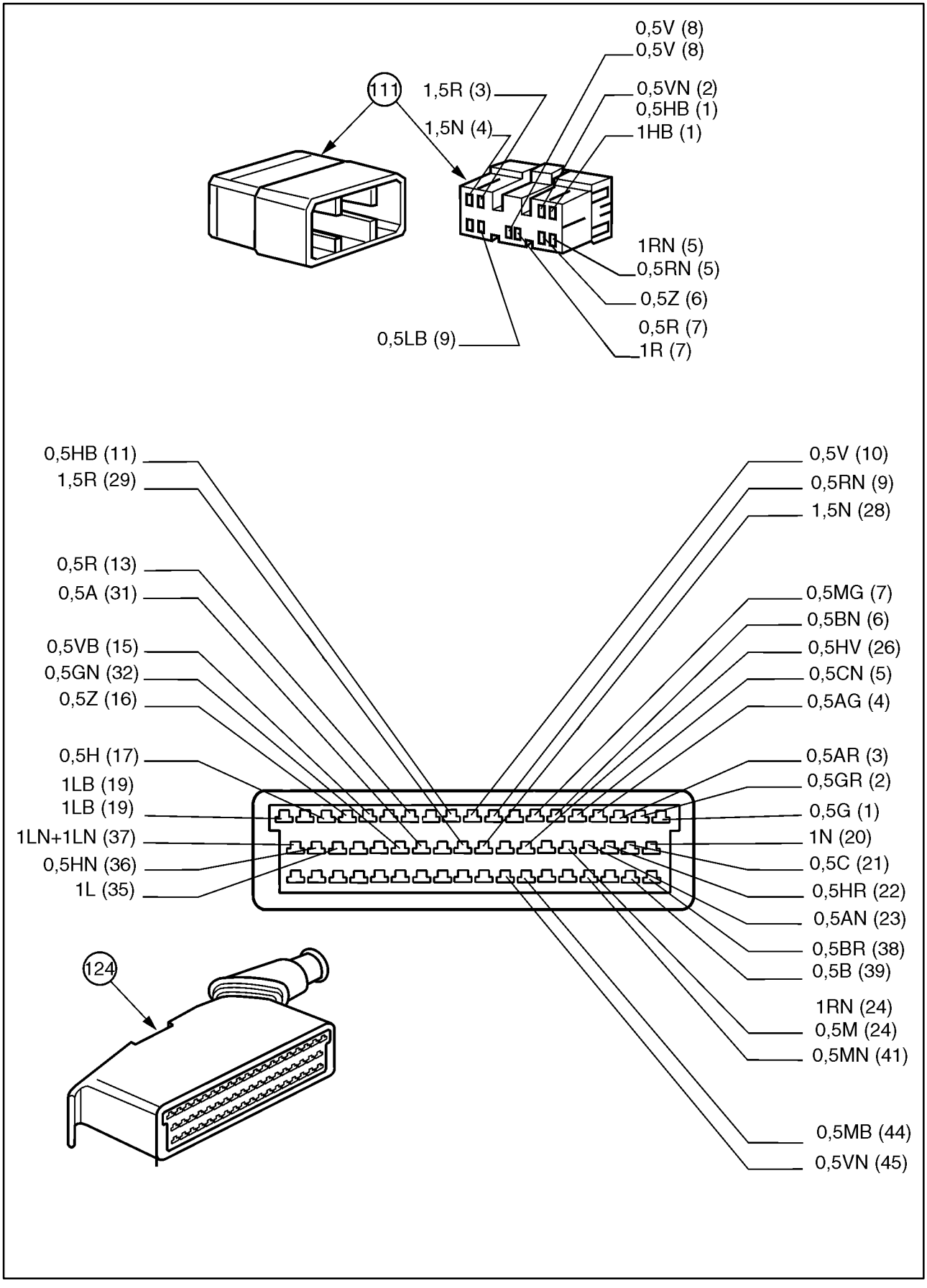
YES → Remove the electronic control unit guard and disconnect the relative connection (124).
Is there electrical continuity on wires (HB) and (VN) between pins 1 and 2 on connection (111) and pins 11 and 45 on control unit connection (124)?

NO → Check the wiring and eliminate the cause of the open circuit.

YES → Replace the electronic control unit.



FAULT CODE 42



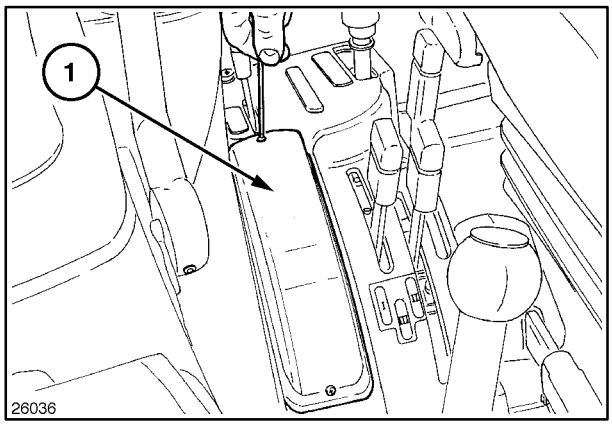
Op. 35 130 30
LIFT ELECTRONIC CONTROL CENTRE
Replacement

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

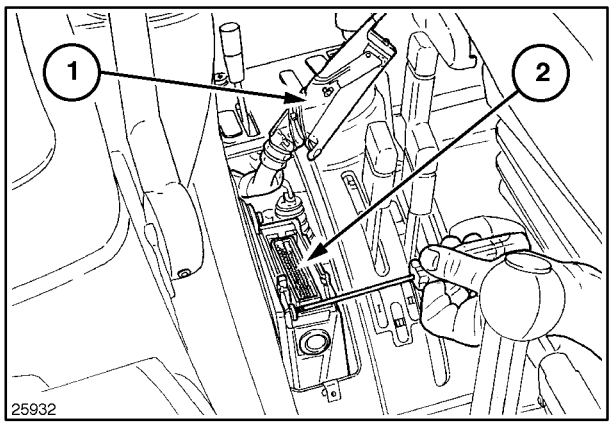
To remove the control unit, proceed as follows.

1. Disconnect and isolate the battery negative lead.
2. Take out the retaining bolts and remove the guard (1).



9

3. Detach the connection (1), take out the retaining bolt and the electronic draft control unit (2) from its support.



10

4. To refit the control unit, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Fit the ECU to the support and connect the connection.
- Assemble the ECU guard.
- Connect the negative cable to the battery.

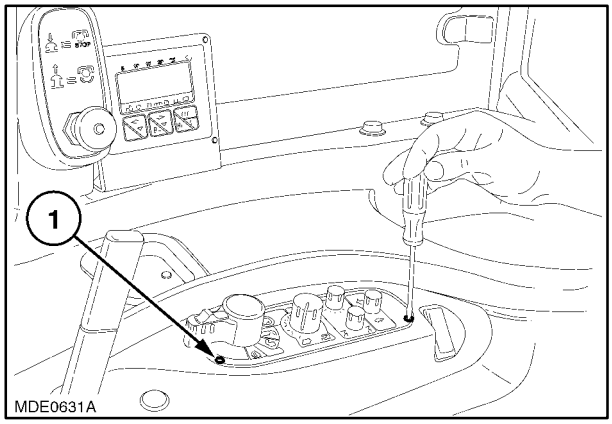
Op. 35 130 31
ELECTRONIC LIFT CONTROL PANEL R.I.

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

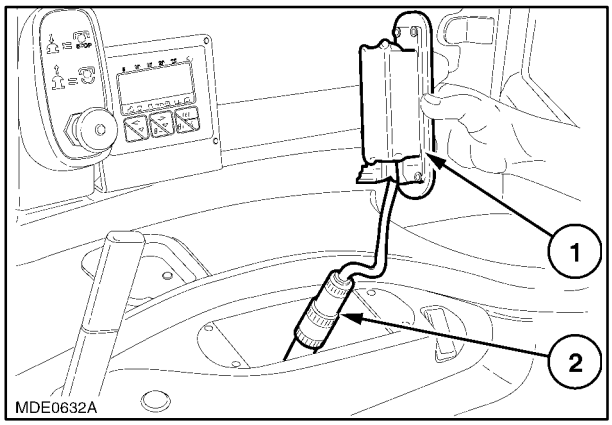
To remove the knobs, proceed as follows.

1. Disconnect and isolate the battery negative lead.
2. Take out the retaining bolts (1) of the electronic lift control knobs.



11

3. Disconnect the electrical connection (2) and remove the control knob unit (1).



12

4. To refit the electronic lift control knobs, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Connect the electrical connection and reposition the control knob unit.
- Secure the electronic lift control knobs unit with the relative bolts.
- Connect the negative cable to the battery.

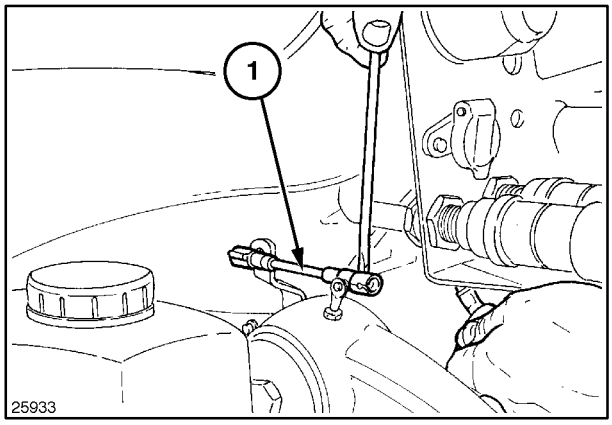
Op. 35 130 36
LIFT ARM POTENTIOMETER
Replacement

CAUTION

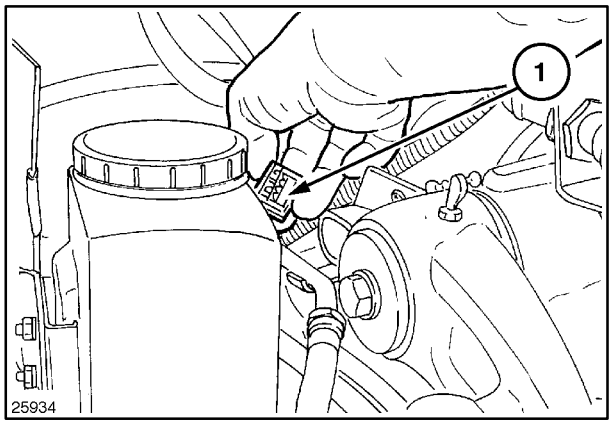
Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

Proceed as follows

1. Disconnect and isolate the battery negative lead.
2. Detach and remove the potentiometer-lift arm connection tie-rod (1).
3. Disconnect the potentiometer connection (1).

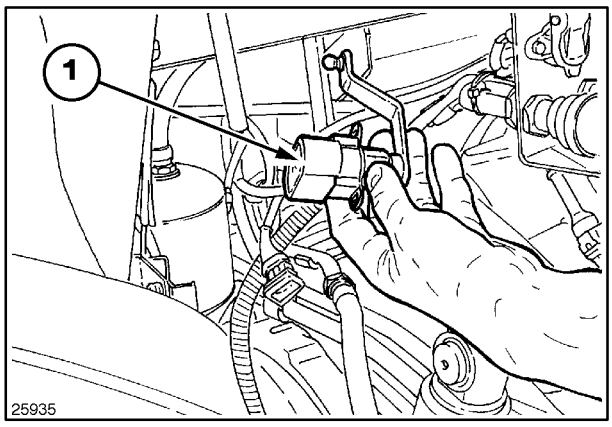


13



14

4. Take out the retaining bolts and remove the potentiometer (1).
5. To refit the potentiometer, proceed as follows.



15

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Assemble the potentiometer.
- Connect to the connection.
- Assemble the potentiometer-lift arm connection.
- Connect the negative cable to the battery.

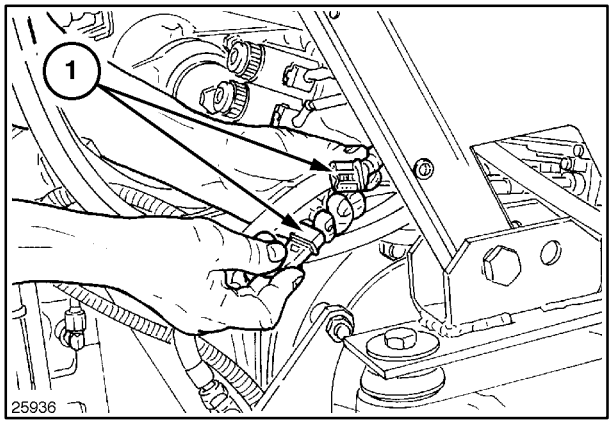
Op. 35 130 56
DRAFT SENSOR R.I.

CAUTION

Handle all parts carefully. Do not put your hands or fingers between parts. Wear suitable safety clothing - safety goggles, gloves and shoes.

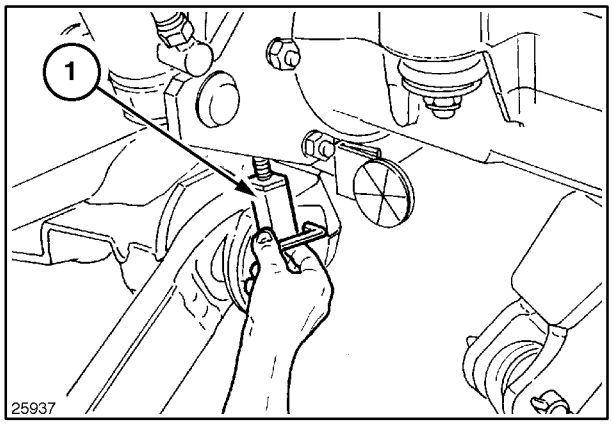
Proceed as follows

1. Disconnect and isolate the battery negative lead.
2. Disconnect the Lift lower arm anti-swing tie-rod.
3. Disconnect the draft sensor connection (1).



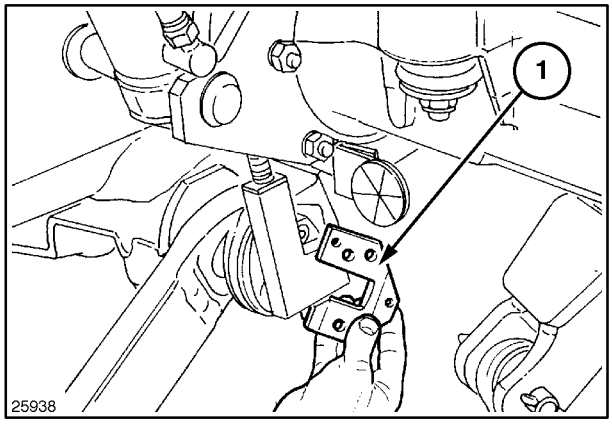
16

4. Take out the sensor guard retaining bolts (1).



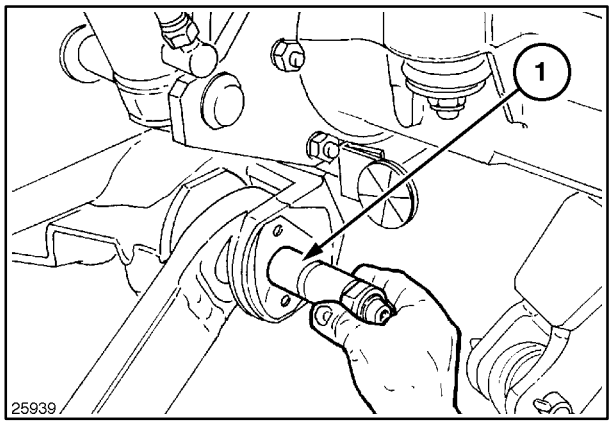
17

5. Remove the draft sensor support bracket (1).



18

6. Slide the guard along the cable and extract the draft sensor (1).



19

7. To refit the draft sensor, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Position the draft sensor in its seat, remembering that the spherical part on the end of the pin (1) must be facing towards the rear of the tractor.

- Fit the guard, sliding it along the cable.

- Position the draft sensor support bracket.

- Attach the guard with the relative screws.

- Connect the electrical connection on the draft sensor.

- Connect the lift lower arm anti-swing tie-rod.

- Connect the battery negative lead.

Op. 35 134 04
ELECTRONIC LIFT CALIBRATION

DANGER

Lift and handle all heavy parts using suitable lifting equipment. Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

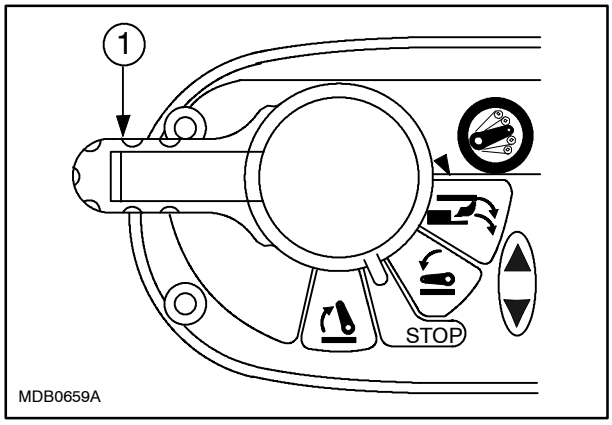
Test conditions:

- Transmission oil at a temperature of 50° to 60°.
- Engine speed: 1200 to 1400 rpm.
- Weight applied to lower arms: 396.83 to 485.01 lbs (kg 180 to 220).

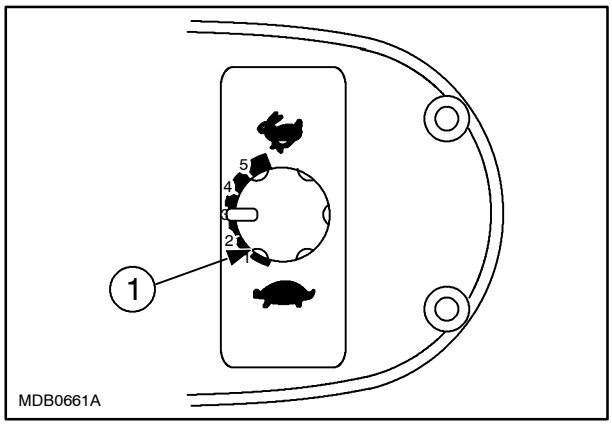
NOTE: *Calibration is required in the event of replacement of:*
- *Electronic control unit;*
- *Lift arm potentiometer;*
- *Connection of the above potentiometer.*
  The control unit can carry out calibration operations at any time, proceeding as follows:
- *with the engine running or the key in the starting position, disconnect the lift arm potentiometer connection.*
  Turn the key to the STOP position and reconnect the potentiometer connection.
  Start the engine again, the faults indicator will flash for 4 seconds at 8 Hz (fast flashing for 4 seconds). Calibration can now proceed.

Proceed as follows.

1. Move the lift-lower lever (1, fig. 20) onto lowering.
2. Turn the lever (1, fig. 21) clockwise to the arm lowering full speed position (on the hare symbol).



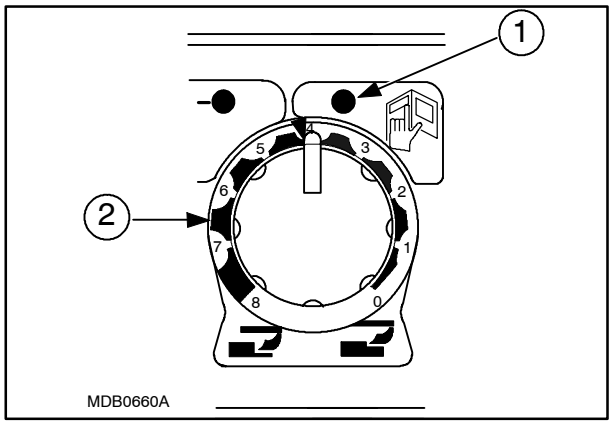
20



21

3. Turn the knob (2) anticlockwise onto number 9 (maximum working depth).
4. Start the engine and bring to the prescribed speed.
5. Turn the knob (2) fully clockwise so the lift arms raise and reach the limit stop.
   If the position of the arms does not vary for a period of > 1 second, the fault code indicator (1) will flash for 2 seconds at 8 Hz (fast flashing for 2 seconds) indicating that the upper limit has been reached.
   At this point, calibration of the arm upper travel limit and the working depth potentiometer maximum limit has been carried out.
6. Turn the knob (2) fully anticlockwise and wait for the arms to lower completely.
   If the position of the arms does not vary for a period of > 1 second, the fault code indicator will flash for 2 seconds at 8 Hz (fast flashing for 2 seconds).
   This means that the calibration operation has been carried out successfully.
7. Turn the key to the STOP position to confirm and store the calibration data in the electronic control unit.

NOTE: *If, when the key is turned to the START position, the indicator (1) flashes for 4 seconds at 8 Hz (fast flashing for 4 seconds), the calibration operation will need to be repeated, proceeding as previously described.*



22

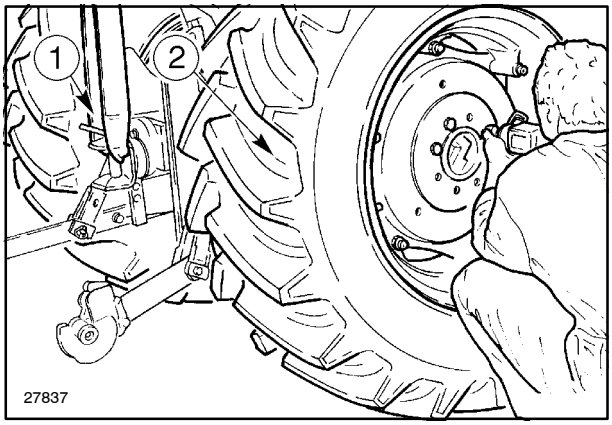
Op. 35 134 30
ELECTRONIC DRAFT CONTROL R.I.

DANGER

Lift and handle all heavy parts using suitable lifting equipment. Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

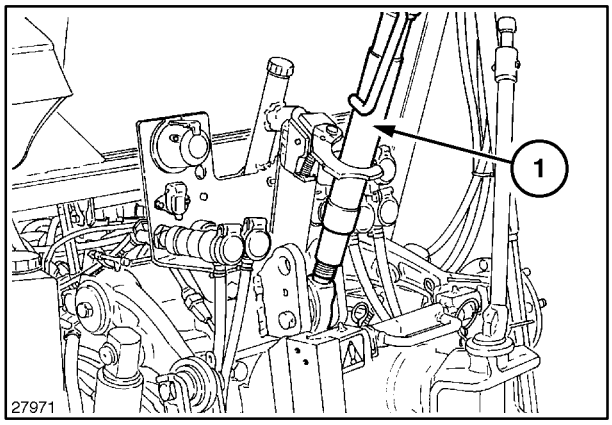
Proceed as follows.

1. Disconnect and isolate the battery negative lead.
2. Lock the front wheels using chocks.
3. Using a hoist and cable (1) raise the rear part of the tractor, positioning two fixed stands under the final drives, then remove the right-hand and left-hand wheels (2).



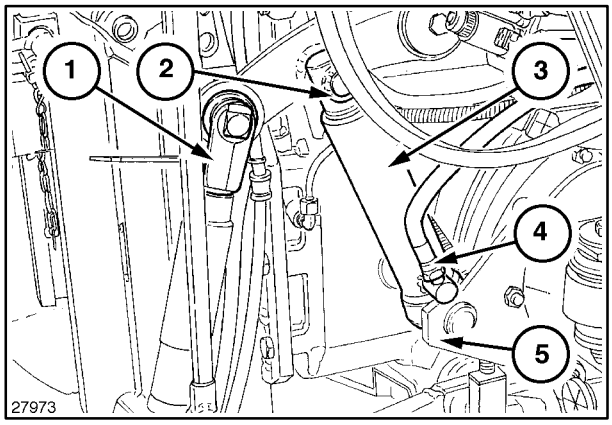
23

4. Remove the top link of the three-point linkage (1).



24

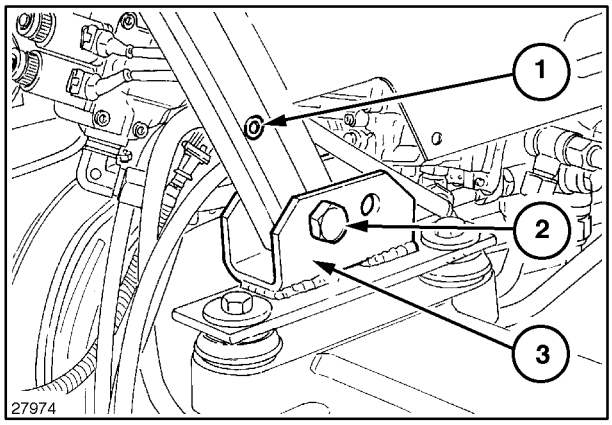
5. Disconnect the vertical tie-rod (1) from the lift arm (on both sides).
6. Remove the snap ring (2), the union (4), the bracket retaining bolts (5) and remove the extra jack (on both sides).



25

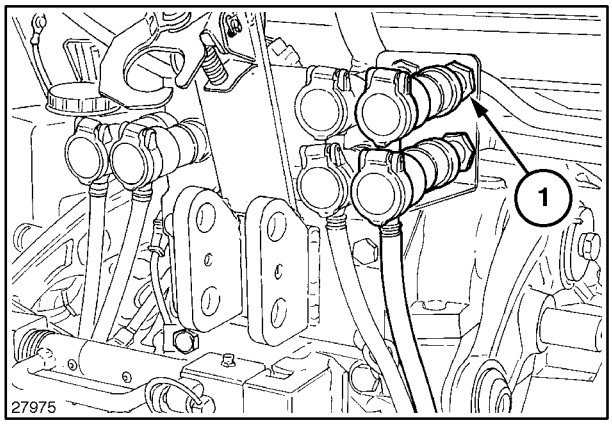
7. Take out the cab rear retaining bolts (2) and loosen the two front ones.

8. Insert a wooden strip 1.9685 to 2.3622 in. (50 to 60 mm) between the upright (1) and relative bracket (3) (on both sides).



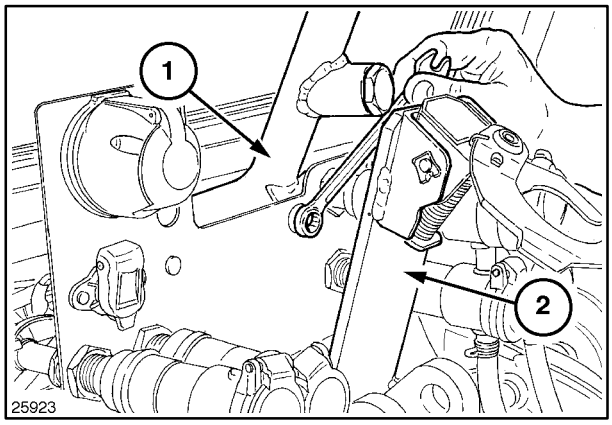
26

9. Loosen the locknuts (1) on the quick-fit couplers support bracket.



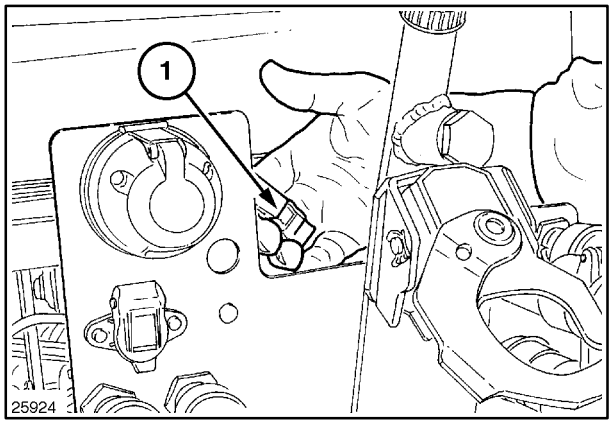
27

10. Take out the bolts securing both the transmission oil fill pipe (1) and the bracket supporting the top link of the three-point linkage (2).



28

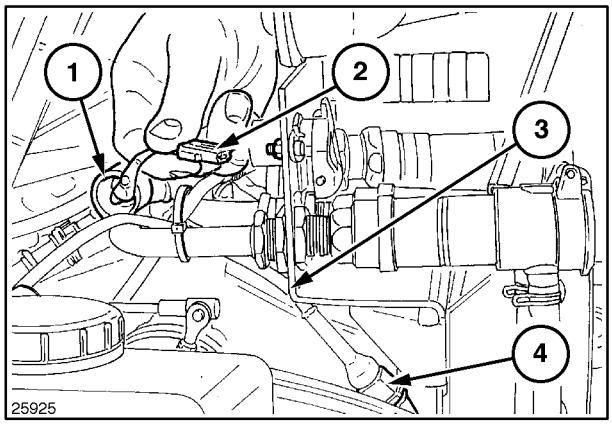
11. Disconnect the seven-pin socket connection (1).



29

12. Remove the guard (1), disconnect the single pole connections (2) and the ground cable on the quick-fit couplers support bracket (3).

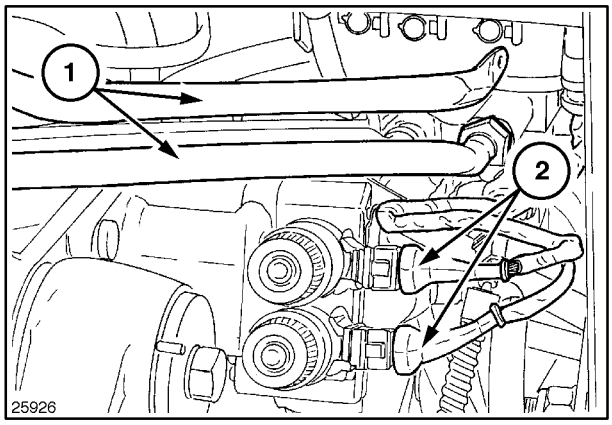
13. Disconnect the power take-off speed sensor connection (4).



30

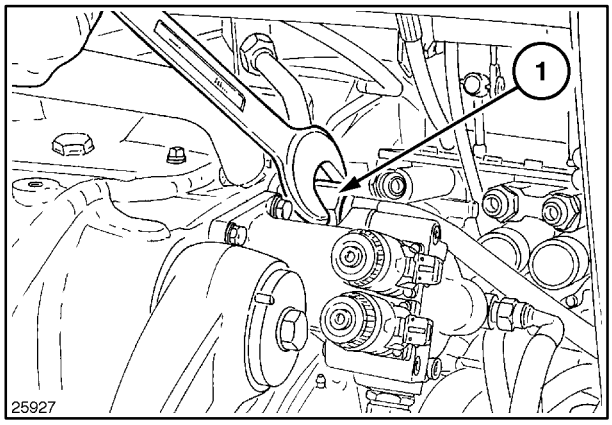
14. Disconnect: the control valve connections (2) and all auxiliary control valve piping (1).

15. Remove the auxiliary control valve quick-fit coupler support bracket and piping.



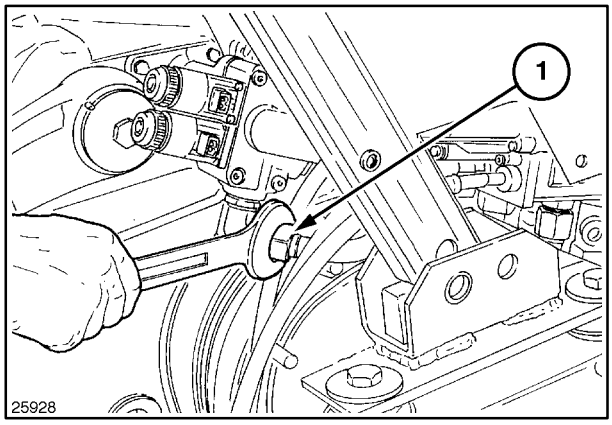
31

16. Disconnect the lift oil discharge line (1) and, if necessary, remove it.



32

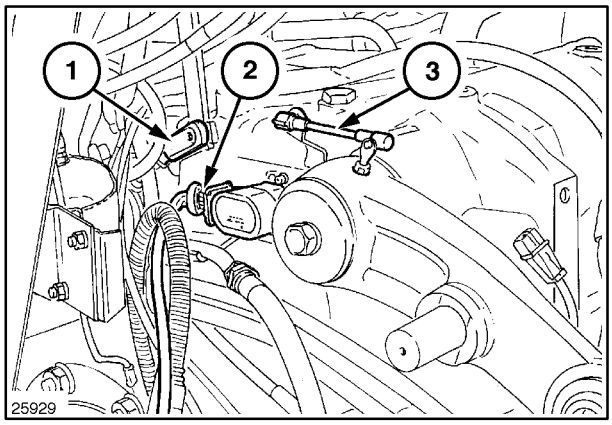
17. Disconnect and remove the lift control valve oil delivery piping (1).



33

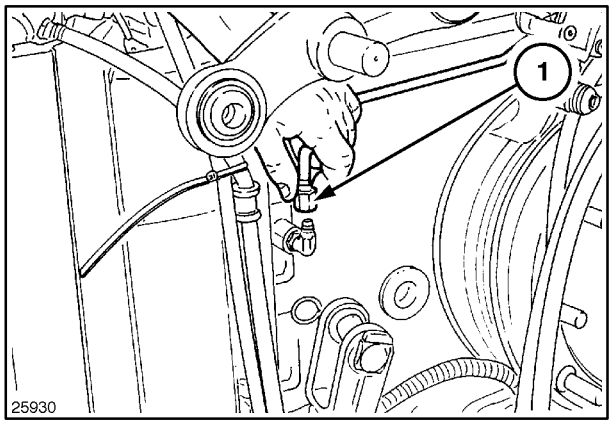
18. If fitted, detach the gear-synchronized PTO transmission lever (1).

19. Disconnect the lift arm position potentiometer connection (2), detach and remove the potentiometer connection tie-rod (3).



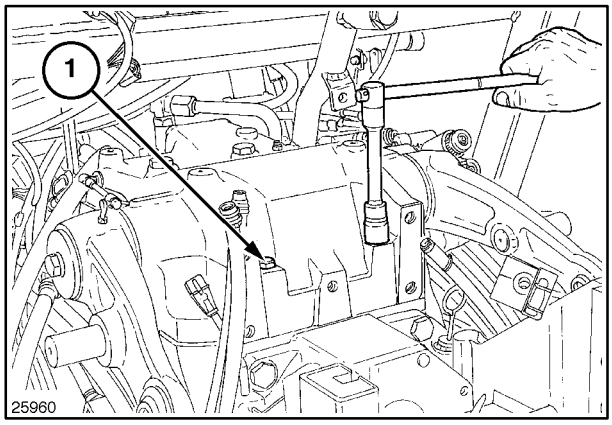
34

20. Disconnect the PTO brake control piping (1).



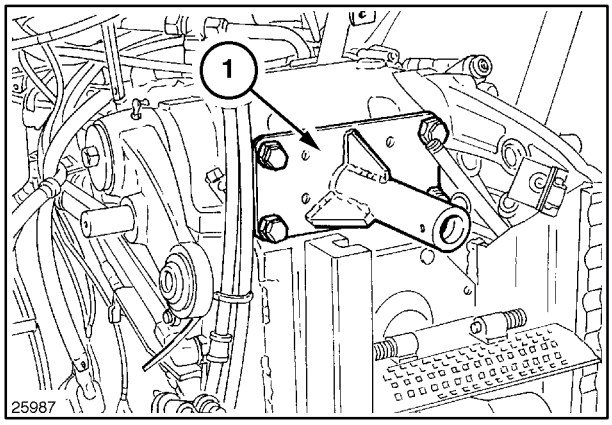
35

21. Unscrew the bolts (1) securing the lift and remove the lift arm position potentiometer.



36

22. Secure the tool **380000238** (1) to the lift.



37

23. Connect tool **380000224** (2) to the hoist and to tool **380000238** (3), raise the hydraulic lift unit by a few centimetres, extract from the rear part, tilting the unit to avoid the internal breather pipe.

24. If necessary, detach the gear-synchronized PTO transmission lever (1), this will make the aforementioned operation easier.

25. To refit the hydraulic lift on the transmission casing, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Reconnect the gear-synchronized PTO transmission lever.

- Before reassembling the hydraulic lift on the rear transmission casing, carefully clean and degrease the mating surfaces, then apply sealing compound [(approx. 0.0787 in. (2 mm)] along the marked line shown in the drawing 39.

- Assemble the hydraulic lift using tools **380000238** and **380000224**.

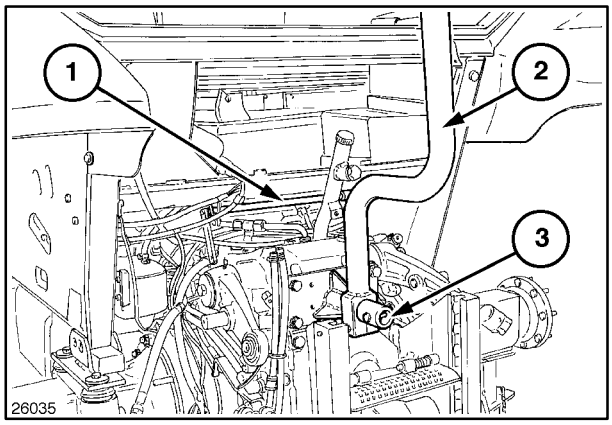
- Secure the lift and potentiometer in position with the relative bolts.

- Connect the PTO brake piping.

- Connect the potentiometer connection, the relative tie-rod and the gear-synchronized PTO lever.

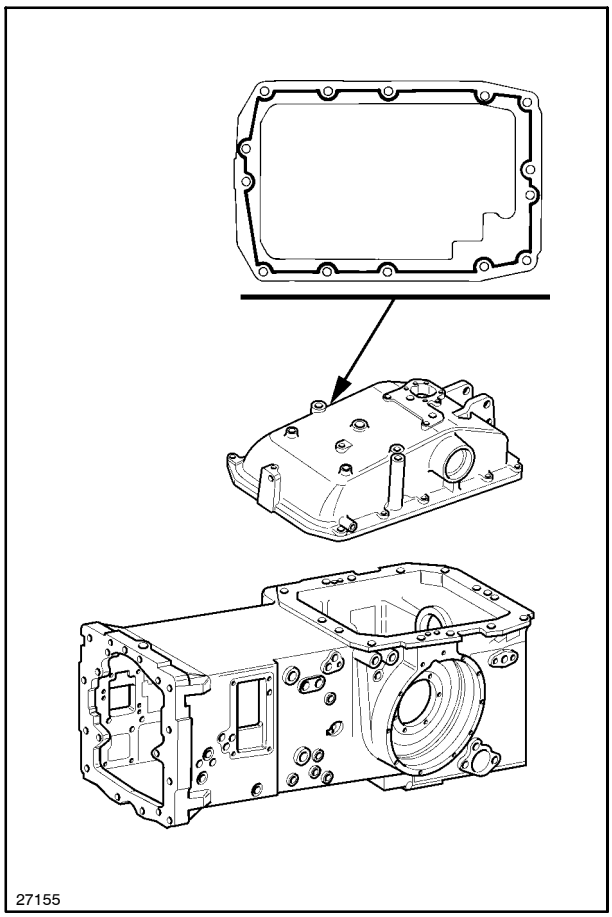
- Assemble the lift oil delivery line.

- Connect the lift oil discharge line.



38

- Assemble the quick-fit coupler support bracket and connect the relative piping to the auxiliary control valves.
- Connect the PTO speed sensor connection.
- Connect the seven-pole and single-pole socket connections.
- Attach the ground cable to the quick-fit coupler support bracket.
- Assemble the oil top up pipe and the top link bracket.
- Fit the quick-fit coupler locknuts.
- Remove the wooden strip and secure the cab.
- Assemble and secure the extra jacks.
- Connect the vertical tie-rods.
- Fit the top link of the three-point linkage.
- Fit and secure the rear wheels.
- Connect the negative cable to the battery.



39

Diagram showing application of sealing compound when fitting the hydraulic lift on the transmission-gear-box casing.

The types of sealing compound are listed in the Repair Manual, section 00.

Op. 35 138 20
HYDRAULIC CONTROL VALVE R.I.

DANGER

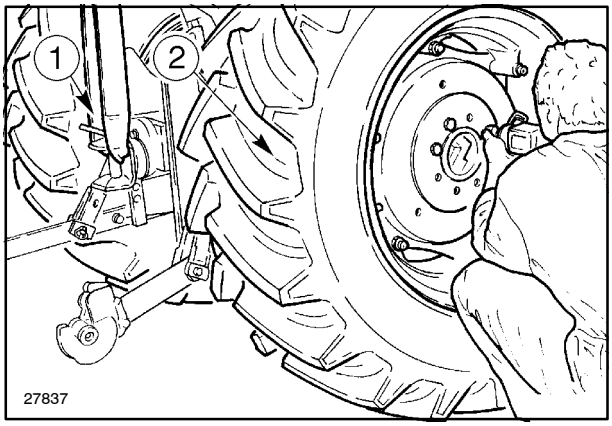
Lift and handle all heavy parts using suitable lifting equipment. Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

Proceed as follows.

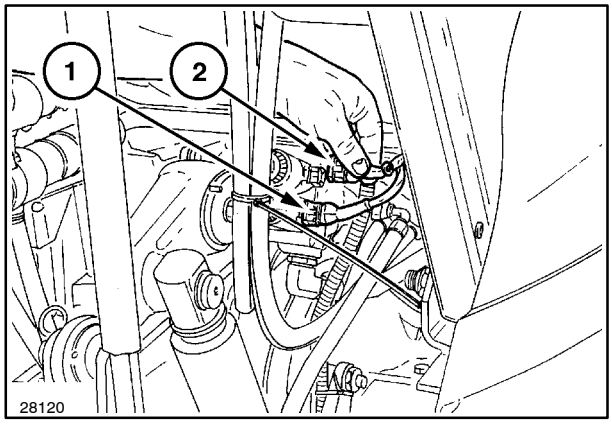
1. Disconnect and isolate the battery negative lead.

2. Lock the front wheels using chocks.

3. Using a hoist and sling (1) raise the rear part of the tractor, position a fixed support stand under the final drive, then remove the rear right-hand wheel (2).
4. Make a reference mark on the connections (1 and 2) and detach from the hydraulic control valve.

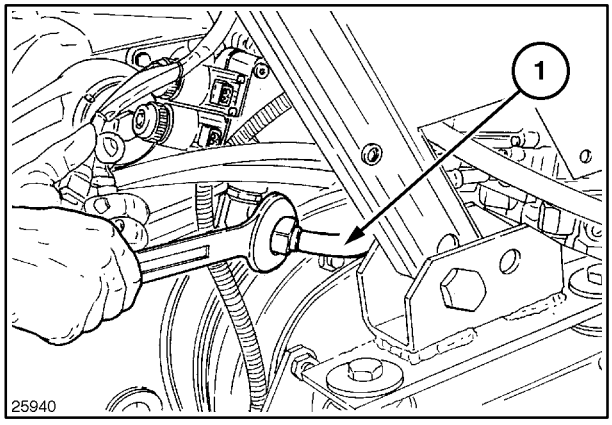


40



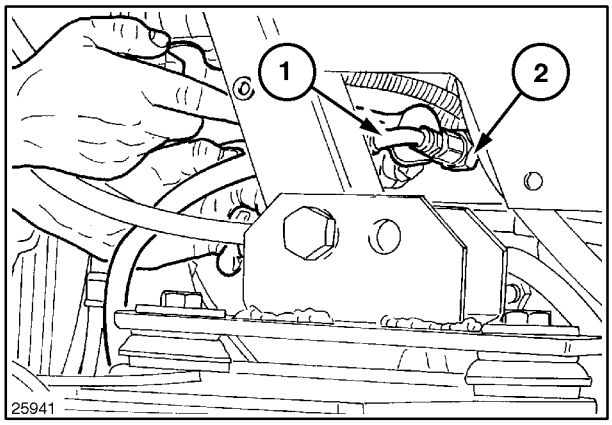
41

5. Disconnect and remove the hydraulic control valve oil delivery piping (1).



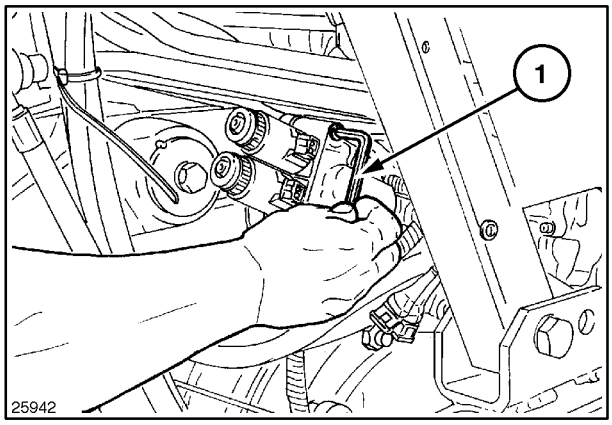
42

6. Disconnect the piping (1 and 2) from the hydraulic control valve.



43

7. Take out the bolts (1) securing the hydraulic control valve to its spacer.



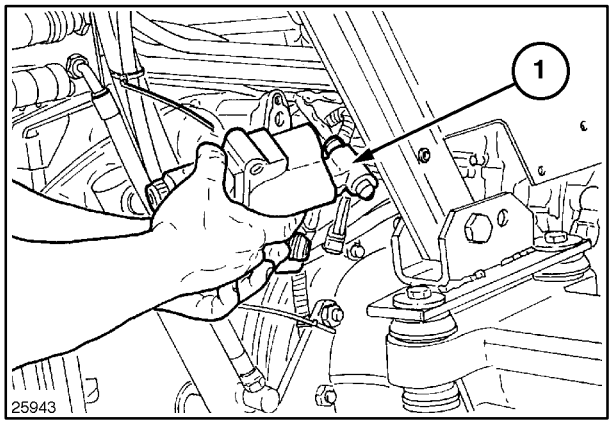
44

8. Remove the hydraulic control valve (1).

9. To refit the hydraulic control valve to the lift, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



45

- Assemble and secure the hydraulic control valve.
- Connect the piping to the distributor.
- Connect the electrical connections.
- Fit the rear right-hand wheel and remove the chocks from the front wheels.
- Connect the battery negative lead.

SECTION 41 - STEERING

Chapter 1 - Steering

CONTENTS

Operation	Description	Page
	Data	2
	Tightening Torques	4
	Components and operating diagrams	5
	Fault diagnosis	11
	Tools	12
41 204 30	Hydrostatic steering control valve R.I.	13
41 204 34	Hydrostatic steering control valve D.A.	19
41 204 38	Hydrostatic steering control valve bench tests	33
41 206 20	Hydrostatic steering oil pump D.A.	35
41 216 10	Front axle steering cylinder R.I.	37
41 216 20	Front axle steering cylinder R.I.	38

DATA

HYDROSTATIC STEERING		
Type		hydrostatic control
Hydraulic circuit		independent, fed by hydraulic pump
Oil filter - 4WD models [and 2WD with Dual Command (2 Speed Power Shift) or hydraulically operated PTO]		paper cartridge on pump intake side
Oil filter - 2WD models [except with Dual Command (2 Speed Power Shift) or hydraulically operated PTO]		metal cartridge, fitted in oil reservoir
Control valve, manufacturer		DANFOSS
Type		ORBITROL, with the rotating valve controlled directly by the steering column; the steering continues to function even if the pump is damaged
Outfit code:		
- All 2WD models and TL70 models with 4WD		OSPC 100 OR - 150 N
- 4WD TL80, TL90 and TL100 models		OSPC 125 OR - 150 N
Pressure relief valve calibration (22, fig. 2)		
- 2WD models (OSPC 100 OR - 150 N)	psi (bar)	2030.63 to 652.70 (140 to 145)
- JX70U models with 4WD (OSPC 100 OR - 150 N)	psi (bar)	2393.24 to 2465.77 (165 to 170)
- 4WD TL80, TL90 and TL100 models (OSPC 125 OR - 150 N)	psi (bar)	2393.24 to 2465.77 (165 to 170)

HYDROSTATIC STEERING HYDRAULIC PUMP		
Type		gear type with incorporated regulated output, oil suction from rear transmission casing(*).
Location		on right-hand side of engine
Pump models		A31 XRP1 and A 31 XRP 2 (●)
Construction		CNH
Operating		via engine timing
Direction of rotation (as seen from drive side)		anticlockwise
Engine speed to pump speed ratio		1:0.931
Maximum rotation speed (with engine at full power)	rev/min	2328
Corresponding rated output	dm^3/min (l/min)	34.5
Rated output at 1000 rpm	dm^3/min (l/min)	14.8
Start of flow control	rev/min	1150
Flow control output	dm^3/min (l/min)	17 to 21
Diameter of driven (2, fig. 1) and driving gear shafts (3)	in. (mm)	0.6850 to 0.6857 (17.400 to 17.418)
Internal diameter of seats in supports (4)	in. (mm)	0.6870 to 0.6877 (17.450 to 17.470)
Clearance between gear shafts (2 and 3) and seats on supports (4)	in. (mm)	0.0012 to 0.0027 (0.032 to 0.070)
- maximum clearance due to wear	in. (mm)	0.0039 (0.1)
Radial clearance of gears (2 and 3) in pump body (1)	in. (mm)	0.0007 to 0.0025 (0.020 to 0.064)
Maximum wear on pump body (1), suction side, at position of gears (2 and 3)	in. (mm)	0.0039 (0.1)
Width of gears (2 and 3)	in. (mm)	0.9448 to 0.9454 (24.000 to 24.015)
Width of supports (4)	in. (mm)	0.9641 to 0.9649 (24.490 to 24.510)
Width of pump body (1) for gear seats (2 and 3) and supports (4)	in. (mm)	2.8793 to 2.8785 (73.135 to 73.160)
End float of gears (2 and 3) complete with supports (4) in pump body (1) (recondition if necessary)	in. (mm)	0.0039 to 0.0070 (0.100 to 0.180)

(*) For 2WD models without Dual Command (2 Speed Power Shift) and hydraulic PTO, the oil is taken from the tank on the right-hand side of the engine.

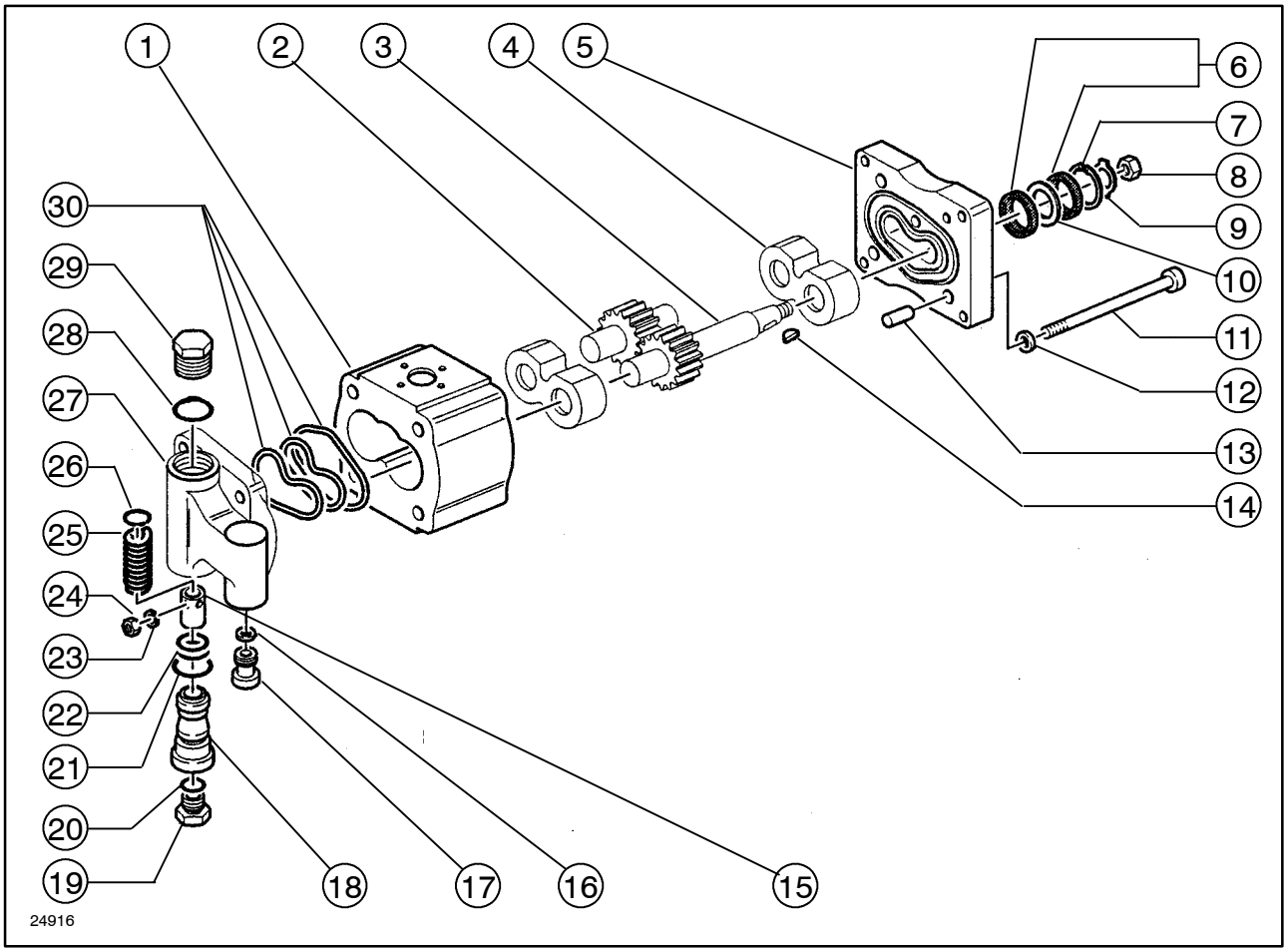
(●) On the A31XRP1 pump the excess delivery is directed to the pump intake side, whereas for the A31 XRP2 pump the excess delivery is directed to the other services.

HYDROSTATIC STEERING HYDRAULIC PUMP (A25 XRP)		
Type		gear type with incorporated regulated output, oil suction from rear transmission casing (*).
Location		on right-hand side of engine
Model		A 25 XRP
Construction		CNH
Operating		via engine timing
Direction of rotation (as seen from drive side)		anticlockwise
Engine speed to pump speed ratio		1:0.931
Maximum speed of rotation (with engine at maximum power 2500 rpm)	rev/min	2328
Corresponding rated output	dm^3/min (l/min)	26.5
Rated output at 1000 rpm	dm^3/min (l/min)	11.35
Start of flow control	rev/min	1200
Flow control output	dm^3/min (l/min)	13 to 17
Diameter of driven (2, fig. 1) and driving gear shafts (3)	in. (mm)	0.6850 to 0.6857 (17.400 to 17.418)
Internal diameter of seats in supports (4)	in. (mm)	0.6870 to 0.6877 (17.450 to 17.470)
Clearance between gear shafts (2 and 3) and seats on supports (4)	in. (mm)	0.0012 to 0.0027 (0.032 to 0.070)
- maximum clearance due to wear	in. (mm)	0.0039 (0.1)
Radial clearance of gears (2 and 3) in pump body (1)	in. (mm)	0.0007 to 0.0025 (0.020 to 0.064)
Maximum wear on pump body (1), suction side, at position of gears (2 and 3)	in. (mm)	0.0039 (0.1)
Width of gears (2 and 3)	in. (mm)	0.7213 to 0.7223 (18.323 to 18.348)
Width of supports (4)	in. (mm)	0.7793 to 0.78 (19.796 to 19.812)
Width of pump body (1) for gear seats (2 and 3) and supports (4)	in. (mm)	2,2862 to 2.2882 (58.072 to 58.122)
End float of gears (2 and 3) complete with supports (4) in pump body (1) (recondition if necessary)	in. (mm)	0.0039 to 0.0078 (0.100 to 0.200)

(*) For 2WD models without Dual Command (2 Speed Power Shift) and hydraulic PTO, the oil is taken from the tank on the right-hand side of the engine.

TIGHTENING TORQUES

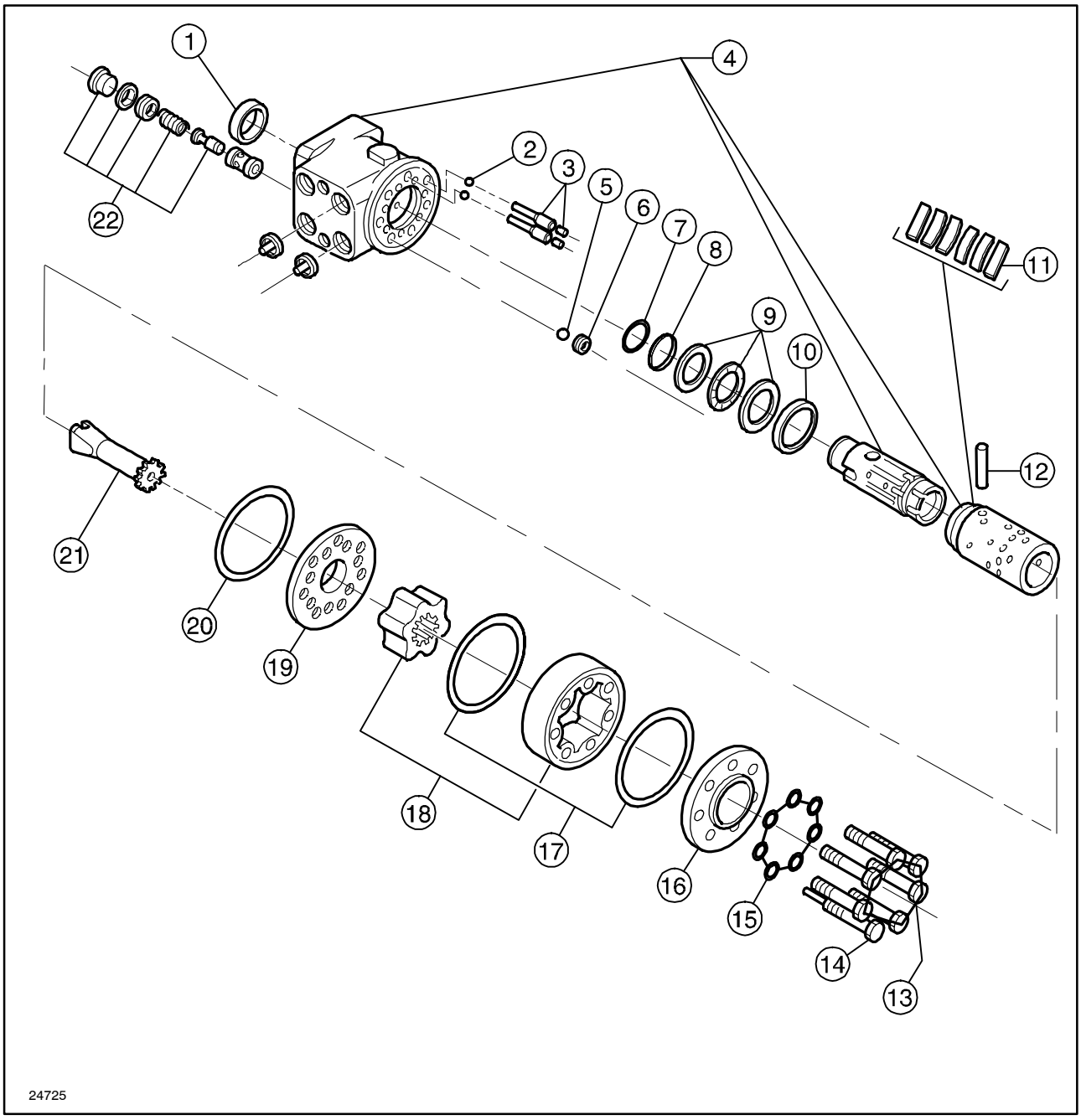
PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Bolt securing power steering unit to tractor	3/8"-16 UNC	44	4.5
Bolt securing cover to power steering housing (13, fig. 2)	M 8 x 1	34	3.5
Hydrostatic steering control pump retaining bolt	M 6 x 1	8	0.8
Nut for pump housing cover retaining bolt (24, fig. 1)	M 10 x 1.25	39	4
Nut for securing thrust sleeve to pump drive shaft (8)	7/16"-20UNF -2B	28	2.8



1

Hydrostatic steering hydraulic pump components

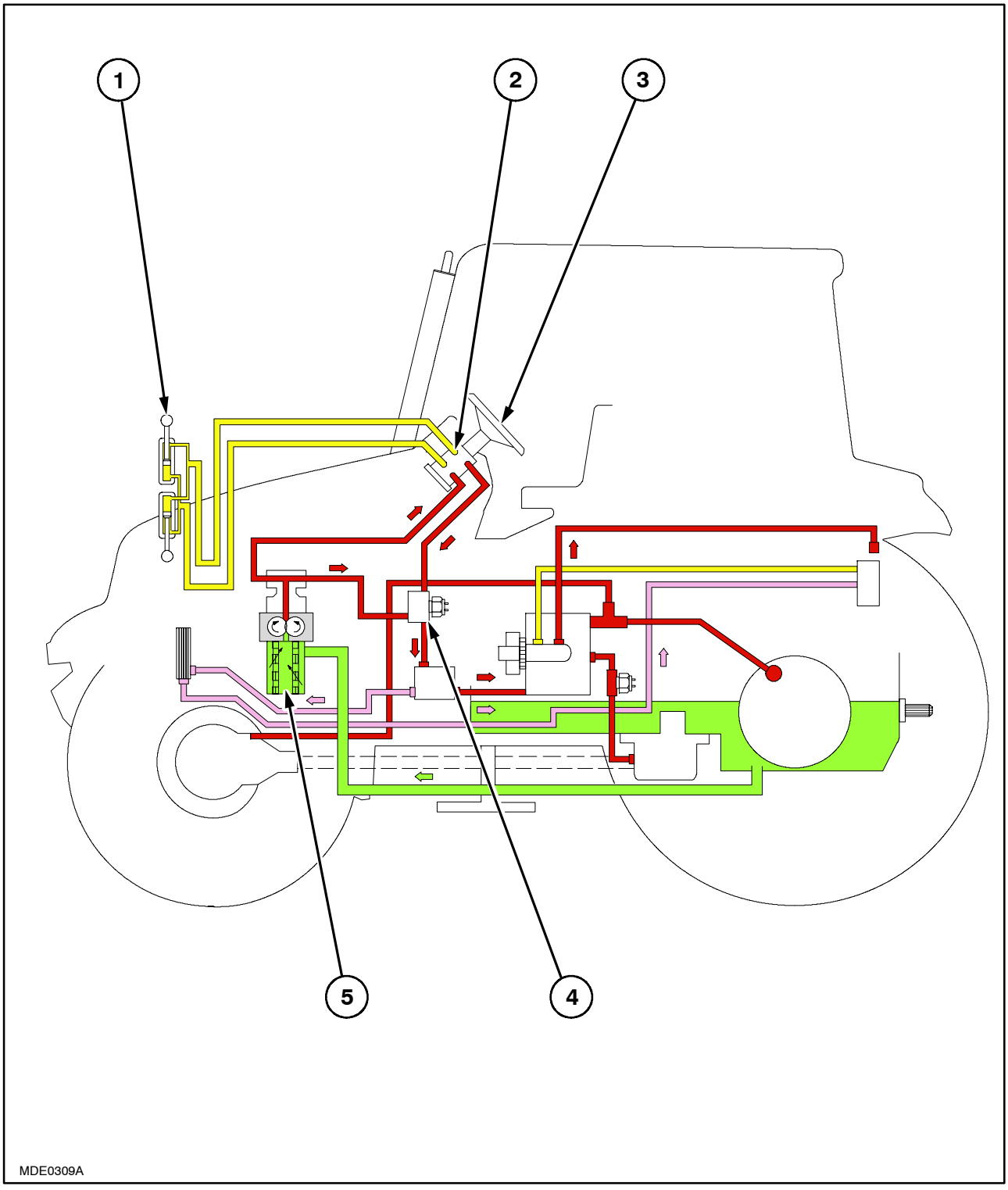
1. Pump body
2. Driven gear shaft
3. Driving gear shaft
4. Gear support
5. Rear cover
6. Driving gear seals
7. Seal snap ring
8. Nut securing sleeve to pump shaft
9. Nut safety washer (8)
10. Spacer
11. Retaining bolt
12. Flat washer
13. Centering bushing
14. Tab
15. Cursor for seat (18)
16. Restrictor ring
17. Plug
18. Seat for cursor (15)
19. Plug
20. Seal
21. Seal
22. 'O' ring seal
23. Washer
24. Retaining nut
25. Spring
26. Ring
27. Front cover
28. Seal
29. Plug
30. Cover seals



2

Hydrostatic steering control valve components

1. Dust ring
2. Backflow valve balls
3. Backflow valve pins
4. Control valve body, rotating valve and rotating valve seat sleeve
5. Non-return valve ball
6. Non-return valve threaded plug
7. O-ring seal
8. Seal ring support ring (7)
9. Thrust bearing components
10. Spring retaining ring (11)
11. Springs for returning sleeve to **neutral position**
12. Sleeve-rotor drive shaft trim pin
13. Cover retaining screws
14. Non-return valve seat screw
15. Washers
16. Cover
17. O-rings
18. Rotor and fixed ring for rotor
19. Shim ring
20. O-ring
21. Rotor drive shaft
22. Pressure relief valve assembly



3

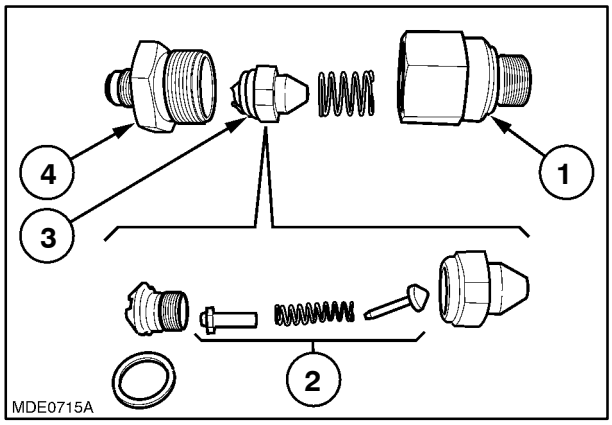
General hydraulic diagram

1. Steering cylinders
2. Steering control valve
3. Steering wheel
4. Anticavitation storage tank
5. Filter
6. Flow divider

Intake oil
Oil in delivery line from pump
Static rest oil
Oil at lubrication pressure

Balancing valve components (2RM)

1. Orbitrol side
2. Internal one-way valve (lets oil flow from orbitrol to cylinder)
3. External one-way valve (lets oil flow from cylinder to orbitrol)
4. Cylinder side

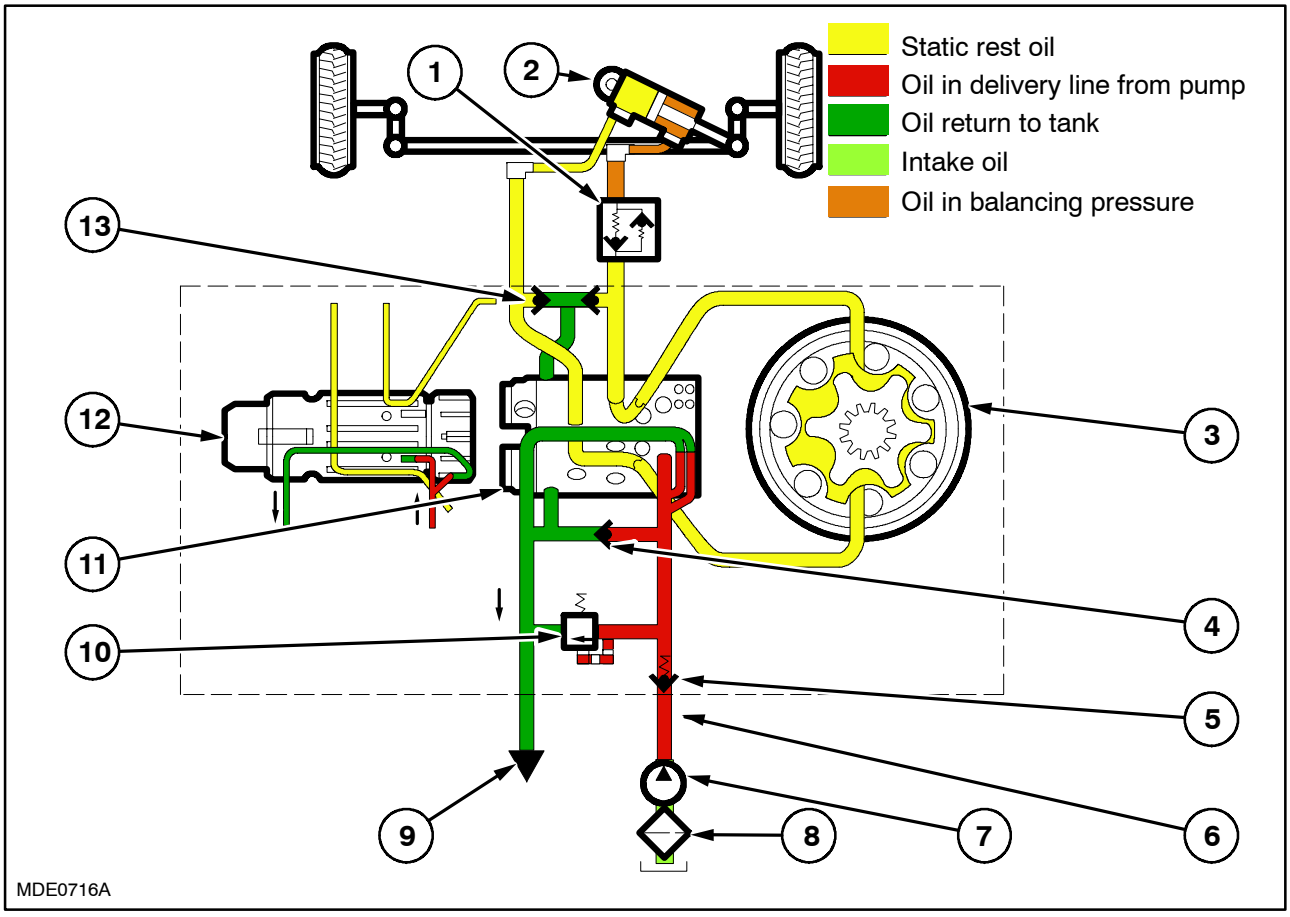


4

2WD tractors are fitted with a single steering cylinder, **the balancing valve** (1, fig. 5) keeps the oil pressure in the chamber on the stem side higher than on the piston side to compensate the lower pressure due to the difference in volume (smaller on the stem side due to the presence of the stem).

4WD tractors do not need a **balancing valve** as there are two steering cylinders that compensate each other.

Operation of this device is described below.



5

Diagram showing 2WD power steering operation

1. Balancing valve
2. Steering cylinder
3. Power steering control valve
4. Check valve
5. Non-return valve
6. Power steering lines
7. Pump
8. Filter
9. Return to rear transmission
10. Pressure relief valve
11. Valve seat sleeve (12)
12. Rotating valve
13. Anti-cavitation valve

OPERATION

The oil intake is from the rear transmission casing by means of the gear pump (7), passing through a filter (8) and directed to the power steering control valve (3).

Turning the steering wheel clockwise (or anticlockwise) causes the steering column to act on the valve (12) that, turning clockwise (or anticlockwise) to the sleeve (11), will send oil through the internal ducts to the hydraulic cylinder (2, fig. 5), or hydraulic cylinders (2, fig. 6) for steering on the right or left of the tractor.

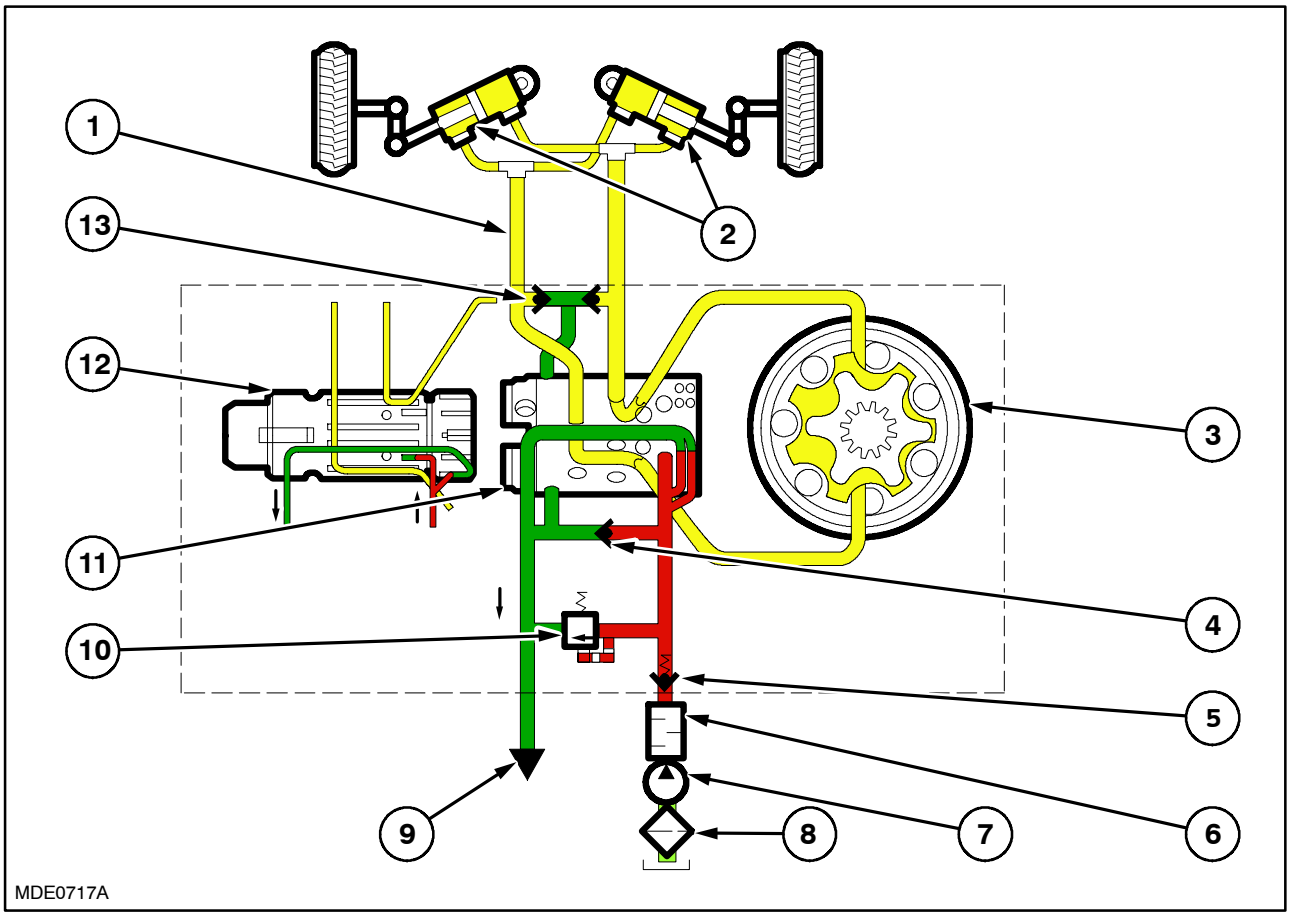
The system is totally hydrostatic without any mechanical connection between the steering wheel and the wheels.

Neutral position (fig. 5 and 6)

With the wheels parallel to the direction of tractor travel, as indicated in the drawing, the rotating valve (12) connected to the steering wheel is in the neutral position on the sleeve (11).

In this position, which is maintained and guaranteed by the springs (11, fig. 2) the internal passages on parts (11 and 12, figs. 5 and 6) are aligned and direct the oil from the pump (7) to the discharge line (9).

- Static rest oil
- Oil in delivery line from pump
- Oil return to tank
- Intake oil



6

Diagram showing 4WD power steering operation

1. Power steering lines
2. Steering cylinder
3. Power steering control valve
4. Check valve
5. Non-return valve
6. Anticavitation storage tank
7. Pump
8. Filter
9. Return to rear transmission
10. Pressure relief valve
11. Valve seat sleeve (12)
12. Rotating valve
13. Anti-cavitation valve

Steering to right* (fig. 7)

When the steering wheel is turned in a clockwise direction, the springs (11, fig. 2) deform, allowing the valve (12, fig. 6) to rotate in relation to the sleeve (11).

Under these conditions the following occurs:

- The internal passages on parts (11 and 12, fig. 6), which were previously communicating in the neutral phase, become misaligned and the oil outflow is interrupted.
- The alignment with the same number of ducts, that are connected with the compartments on the rotor in the pump suction phase (7, fig. 6) and in the delivery phase of the steering cylinders (2), allow turning to the right to be carried out.

Steering to the left*

When the steering wheel is turned anticlockwise, the internal grooves on parts (11 and 12, fig. 6) and the delivery to the steering cylinder are inverted, allowing turning to the left to be carried out.

Manual turning to the right*

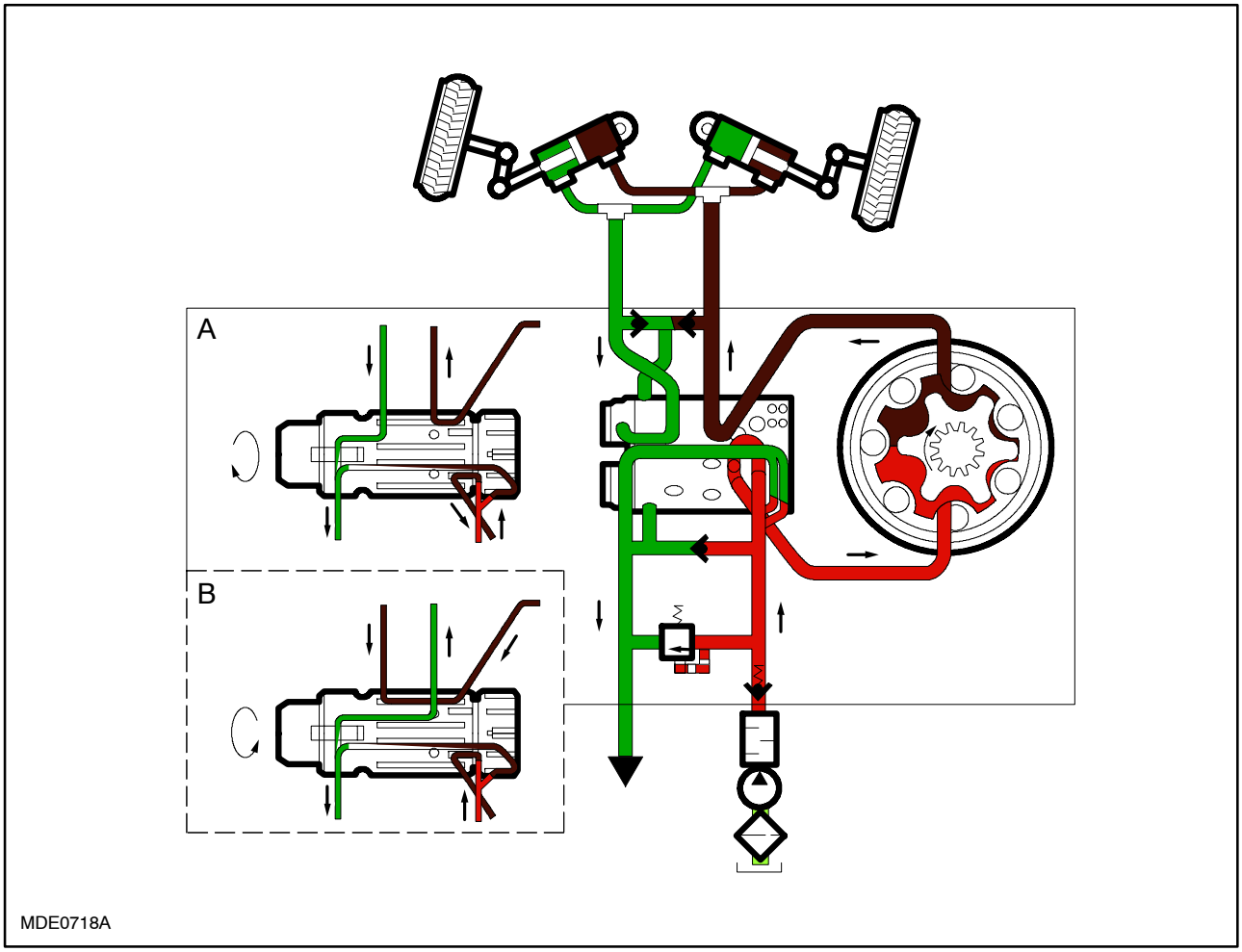
In the event of power steering pump failure or insufficient oil pressure, turning is possible manually.

When the steering wheel is turned in a clockwise direction, the power steering control valve (3, fig. 6) internal rotor operates as a hand pump, directing the oil to the rod side of the cylinders (2), allowing manual turning to the right.

Manual turning to the left *

When the steering wheel is turned anticlockwise, the internal power steering control valve rotor operates as a hand pump (as previously described), directing the oil to the cylinder piston side, allowing manual turning to the left.

NOTE: * This description holds also for the 2WD model shown in fig. 5.



7

Diagram showing 4WD power steering operation

A. Steering to the right
B. Steering to the left

Oil in delivery line to hydraulic cylinder

Oil in delivery line from pump

Intake oil

Oil return to tank

HYDROSTATIC STEERING TROUBLESHOOTING

Problems	Possible Causes	Solutions
Oil leaking from the hydrostatic steering unit: a. Control side. b. Cover side.	1. Seal (7-8, fig. 2) faulty.	Replace the seal (7) and relative anti-extrusion ring (8) using tool **380000281** or **380000305**.
	2. Bolts insufficiently tightened (13).	Tighten the bolts to the prescribed torque (24 to 36 Nm - 2.5 to 3.7 kgm).
	3. Sealing washers (15) or O-rings (17) faulty.	Renew the washers and seals.
Steering wheel excessively stiff.	1. Hydraulic pump faulty.	Repair the pump.
	2. Non-return valve (5) held open by foreign bodies or due to absence of ball.	Eliminate foreign bodies and clean filter; place a new ball in the seat (if missing).
	3. Pressure relief valve (22) incorrectly set.	Calibrate the valve correctly.
	4. Pressure relief valve (22) jammed or held open by foreign bodies.	Eliminate foreign bodies and clean filter.
	5. Steering column has become stiff on its bushing due to rusting, seizing, etc.	Eliminate the causes.
Excessive steering wheel play.	1. Excessive play between the steering column and the coupling with the rotating valve (12, fig. 6).	Replace the worn parts.
	2. Excessive play in the coupling between the shaft (21, fig. 2) and the trim pin (12).	Replace the worn parts.
	3. Excessive play in the splined coupling between the shaft (21) and the rotor (18).	Replace the worn parts.
	4. Combination of excessive play as described in the previous points.	Replace the excessively worn parts.
	5. Leaf springs (11) damaged or fatigued.	Renew the springs.
The steering wheel turns normally, but the steering is: a. Slow. b. Null.	1. Inadequate control cylinder seal.	Replace the seal.
	2. Cylinder rod broken.	Replace the damaged part.
	3. Rotor control shaft (21) or pin (12) broken.	Replace the damaged part.
With the engine stopped, the steering wheel can be turned without turning the wheels.	1. Excessive wear between rotor and fixed ring (18).	Replace the worn parts.
	2. Non-return valve damaged.	Replace the control valve.

(continued)

HYDROSTATIC STEERING TROUBLESHOOTING

(cont)

Problems	Possible Causes	Solutions
Steering wheel jolts, steering uncontrollable, wheels steering in the opposite direction to the desired direction.	1. Incorrect synchronisation of hydrostatic steering.	Synchronise correctly.
	2. Pipes to cylinder inverted.	Connect correctly.
The wheels do not maintain the desired alignment and continual correction with the steering wheel is necessary.	1. Hydraulic cylinder piston seal worn.	Replace the seal.
	2. Backflow valve (2, fig. 2) held open by foreign bodies or damaged.	Eliminate foreign bodies and clean filter or replace the control valve.
	3. Control valve mechanical wear.	Replace the control valve.
Neutral phase of hydrostatic steering unobtainable. During manual control, operation is normal; when stopping manual control the steering wheel tends to move on its own, or remain stationary, but steering continues slowly in the direction that was initially selected ("motoring"), therefore steering must be continually corrected with the steering wheel.	1. Leaf springs (11), for sleeve (4) return to neutral position, damaged or fatigued.	Replace the leaf springs assembly.
	2. Sleeve and rotating valve (4) locked in delivery position because of the presence of foreign bodies.	Eliminate foreign bodies and clean filter.
	3. Sleeve (4) crushed on the rotating valve due to excessive pressure.	Check the pressure relief valve calibration (22, fig. 2).
Vibrations on front wheels (shimmy).	1. Air pockets in the hydraulic cylinder.	Bleed the air and eliminate the causes of possible infiltration.
	2. Wear on mechanical joints on steering rods.	Replace the worn parts.
	3. Backflow valve (2) held open by foreign bodies or damaged.	Eliminate foreign bodies and clean filter or replace the control valve.
Difficulty in steering in general, or in one direction.	1. Insufficient pressure.	Check the hydraulic pump and the pressure relief valve calibration (22, fig. 2).
	2. Excessive leakage inside the control valve.	Replace the control valve.

TOOLS

WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

X 380000210 Tool for fitting dust ring on control valve body.

X 380000281 Tool for fitting **ROTOGLYD** seal on rotating valve.

X 380000305 Tool for fitting **KIN-RING** seal on rotating valve.

380000306 Plug for fitting the hydrostatic steering rotating valve return springs.

X 380000307 Hydrostatic steering rotor retaining lever.

X 380000223 Steering wheel extractor.

X 380000240 Universal pressure testing kit.

0p. 41 204 30
HYDROSTATIC STEERING CONTROL VALVE R.I.

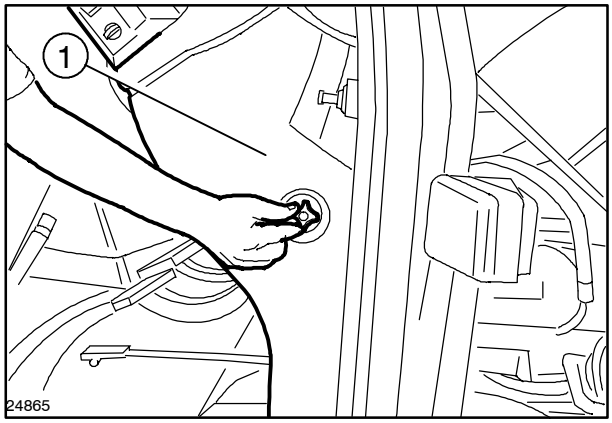
CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts. Wear suitable safety clothing – safety goggles, gloves and shoes.

To remove the power steering control valve, proceed as follows:

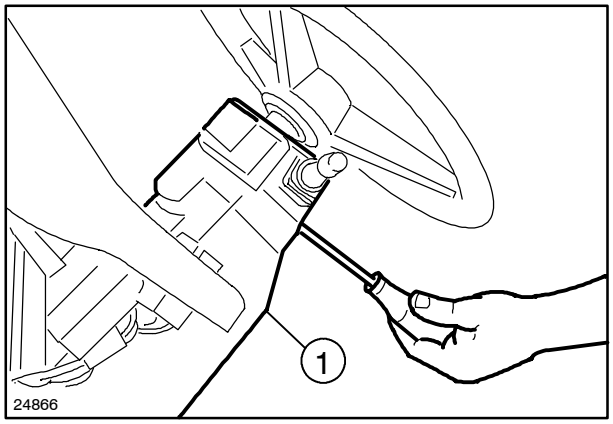
1. Detach the tool box and relative support bracket.

2. Remove the right and left-hand panels (1) on the instrument panel.



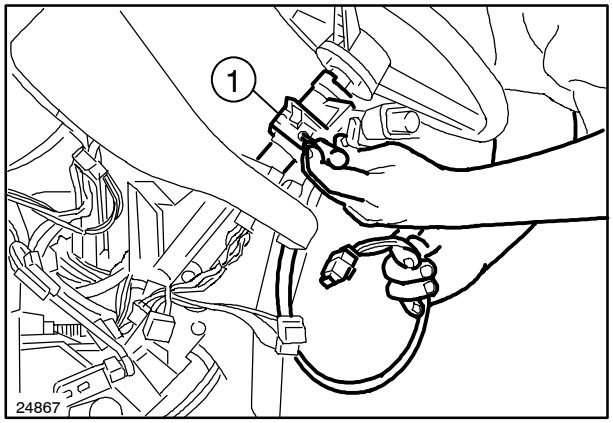
8

3. Remove the steering column casing (1).



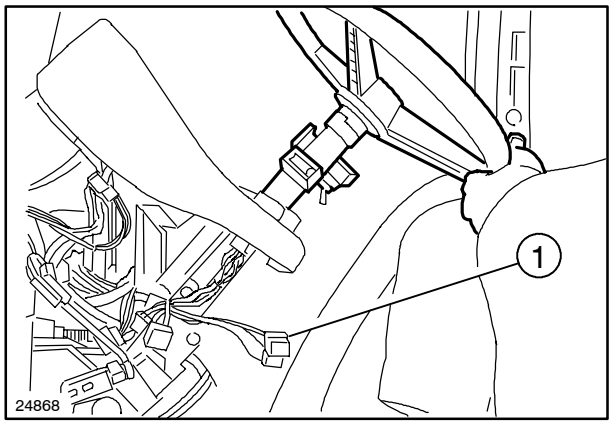
9

4. Unscrew the retaining bolts (1) securing the lights cluster to the column.



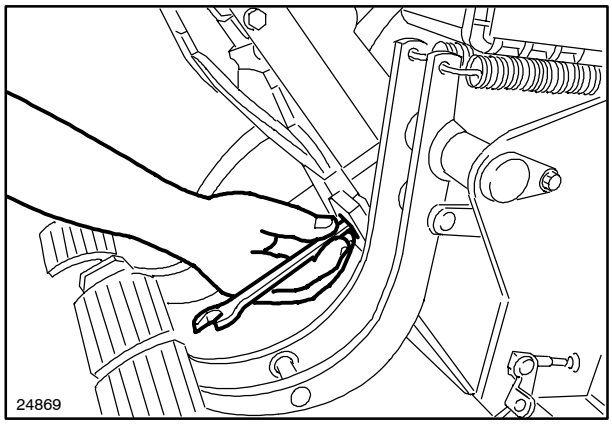
10

5. Disconnect the connections (1) on the tractor starting unit.



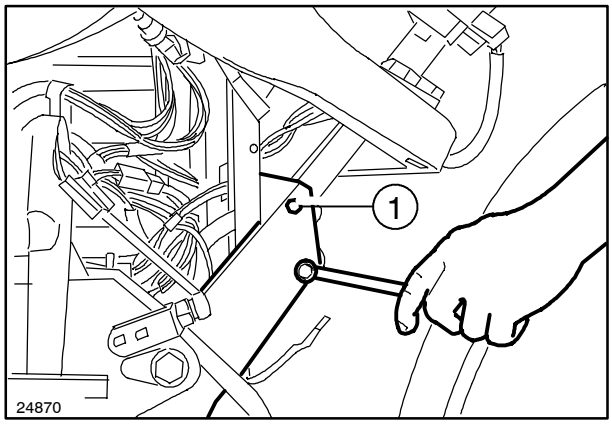
11

6. Extract the steering column shaft locking pin from the power steering control valve and unscrew the four control valve retaining bolts.



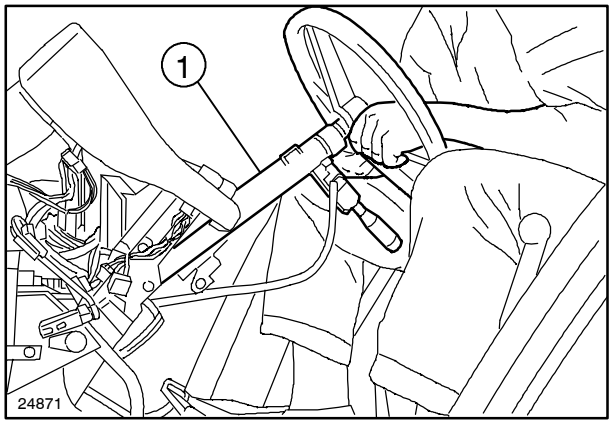
12

7. Unscrew the steering column retaining bolts (1).



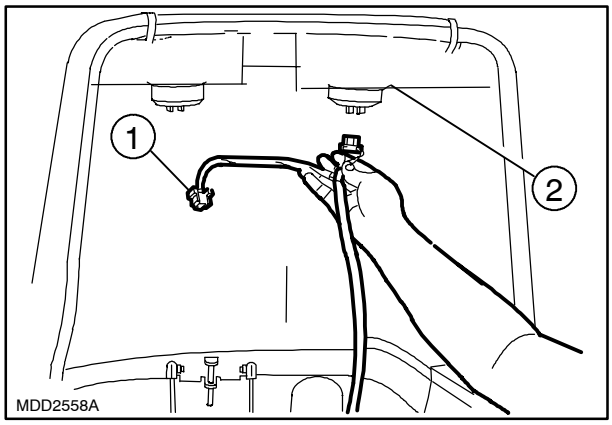
13

8. Remove the steering column (1) to create more space for the power steering unit removal operations.



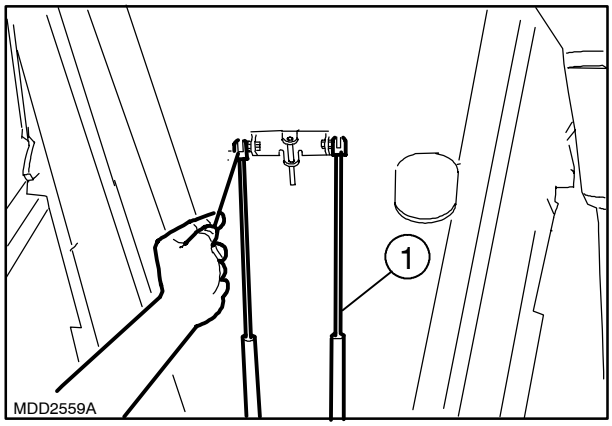
14

9. Remove the exhaust pipe, raise the bonnet and disconnect the front headlights (2) connections (1).



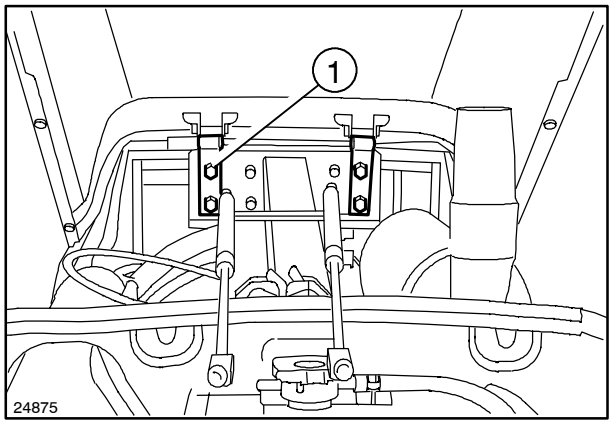
15

10. Detach the gas springs (1) on the bonnet.



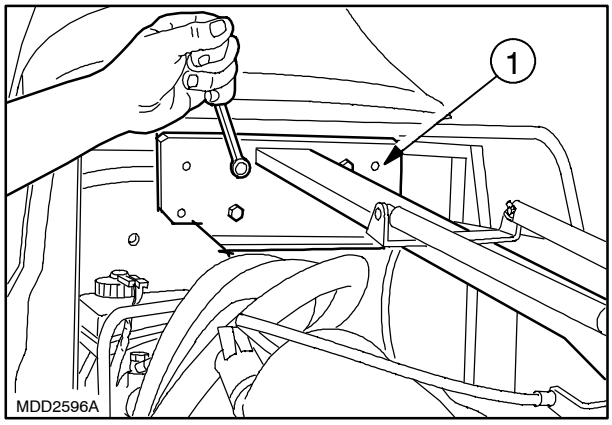
16

11. Unscrew the four pivot bolts (1) and remove the bonnet.



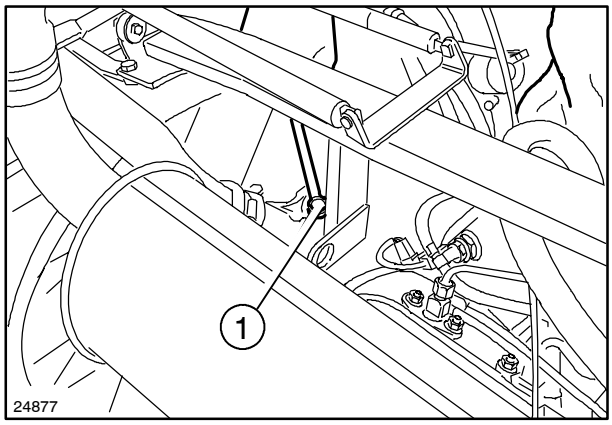
17

12. Detach the bonnet support rear bracket (1).



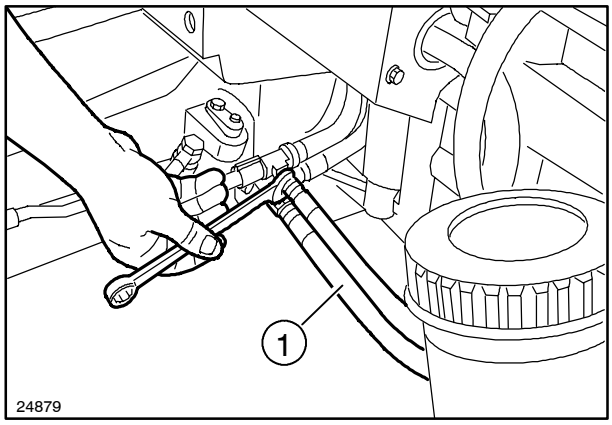
18

13. Detach the bonnet support front bracket (1).



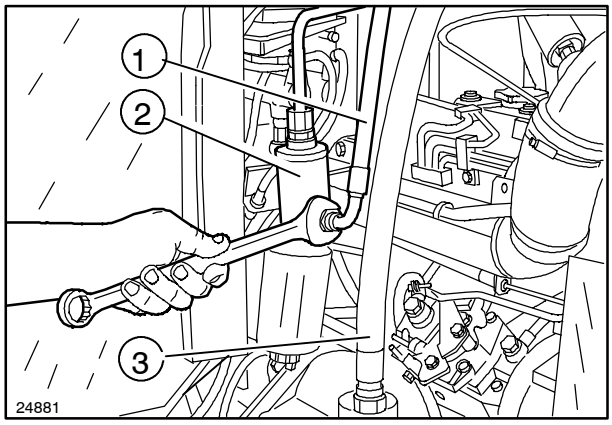
19

14. Disconnect the two oil delivery/return hoses (1) to the power steering cylinders and detach the clamp.



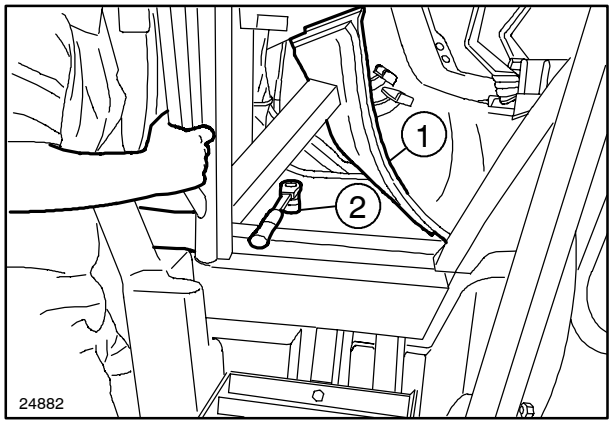
20

15. Disconnect the hose (1) on the anticavitation storage tank (2), located on the power steering unit return, and the hydraulic pump delivery hoses (3).



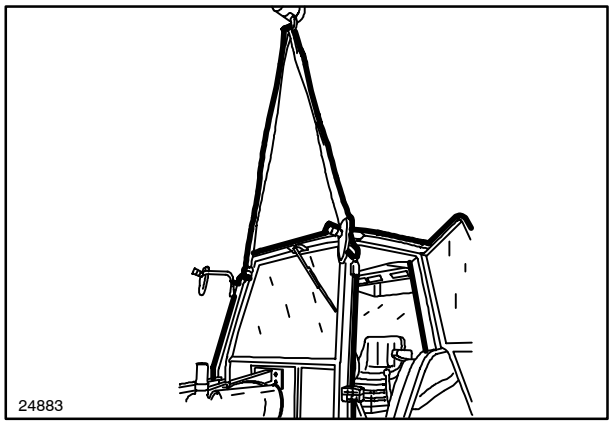
21

16. Raise the cab floor covering (1) and unscrew the two bolts (2) (one on each side) securing the cab to the relative supports.



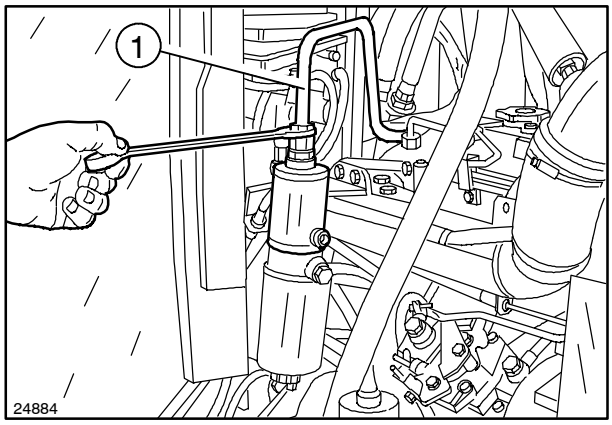
22

17. Raise the cab from the front by approximately 2.3622 in. (6 cm).



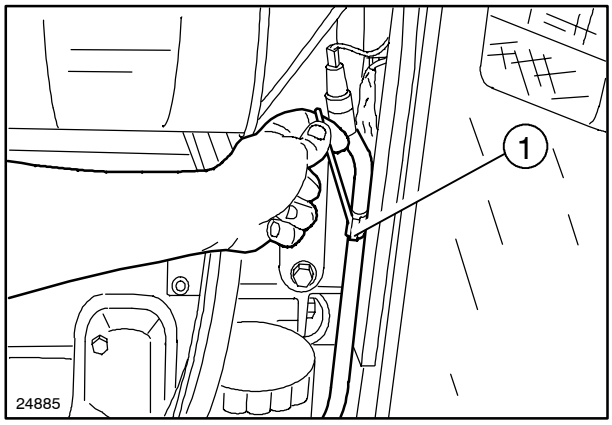
23

18. Disconnect the rigid oil delivery line (1) to the services control valve.



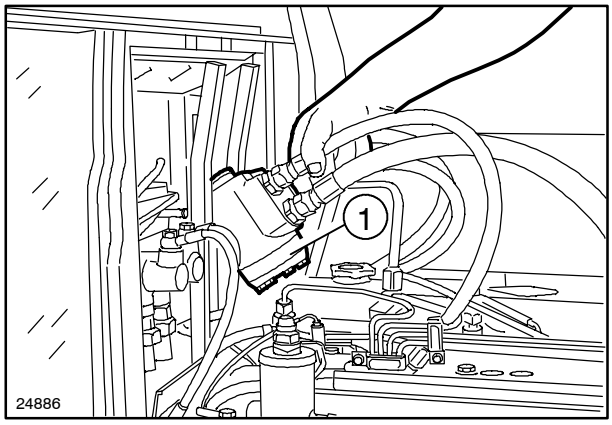
24

19. Unscrew the retaining bolt from the bracket (1) and move the end of the pipe forwards.



25

20. Remove the power steering control valve assembly (1) from the front.



26

21. To fit the power steering control valve, proceed as follows:

CAUTION

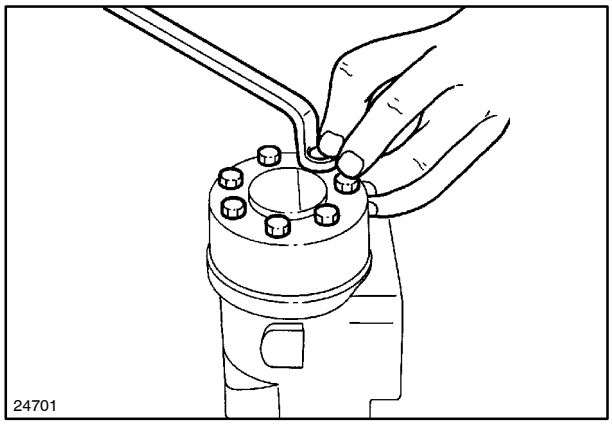
Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Reassemble the power steering control valve and secure inside the cab with the four bolts.
- Refit the power steering control valve steering column shaft.
- Lower the cab.
- Reposition the steering shaft locking pin.
- Tighten the oil delivery line to the services control valve and secure the clamp on the left–hand side.
- Reconnect the power steering delivery and return hoses.
- Reconnect the hoses on the power steering cylinder union.
- Secure the two lines with the relative clamp.
- Refit the bonnet support bracket.
- Refit the two cab front retaining bolts and reposition the floor covering.
- Secure the steering column in position with the four retaining bolts.
- Pass the lights cluster lever to the lower panel, connect the connecting pin and secure the lever to the steering column with the two bolts.
- Reconnect the engine starter electrical connection.
- Refit the column upper panel and secure to the lower panel with the retaining bolts.
- Fit the two side panels on the steering column and secure with the four knobs.
- Refit the bonnet, fit the pivot to the support bracket, reconnect the two raising pistons and the front headlight connections.
- Reassemble the bracket and the tool box.
- Close the hood and refit the exhaust pipe.

0p. 41 204 34
HYDROSTATIC STEERING CONTROL VALVE D.A. with control valve removed

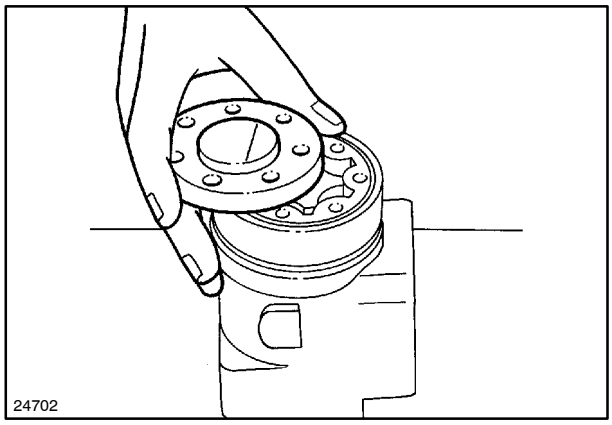
To disassemble the hydrostatic steering control valve, proceed as follows:

1. Remove the cover retaining bolts.



27

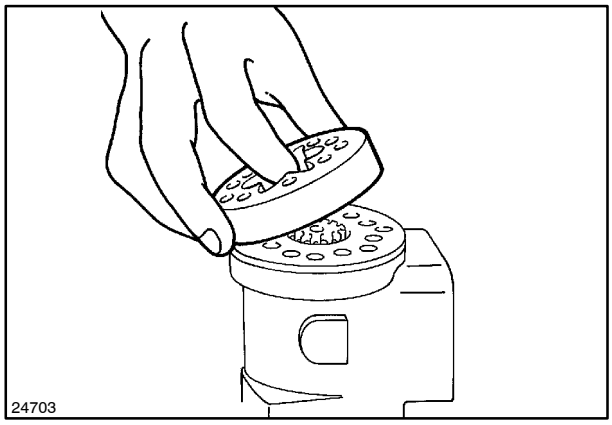
2. Remove the cover by sliding to the side.



28

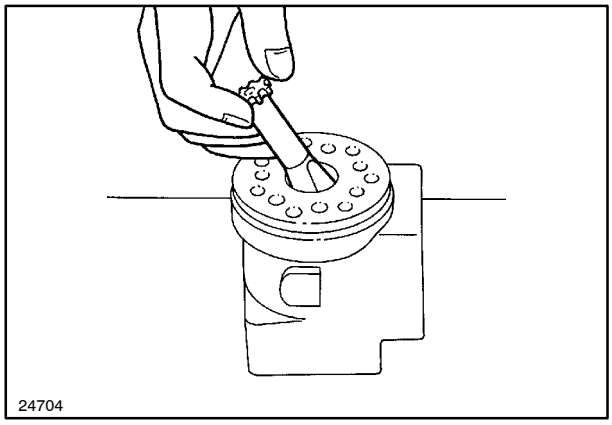
3. Remove the rotor fixed ring, the rotor and the inner spacer.

4. Remove the two O-rings on the rotor fixed ring.



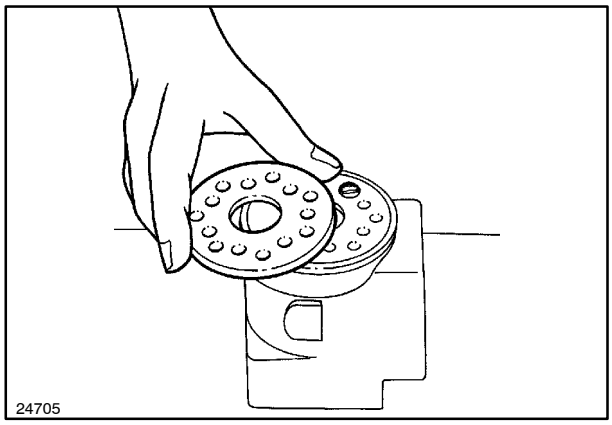
29

5. Extract the rotor drive shaft.



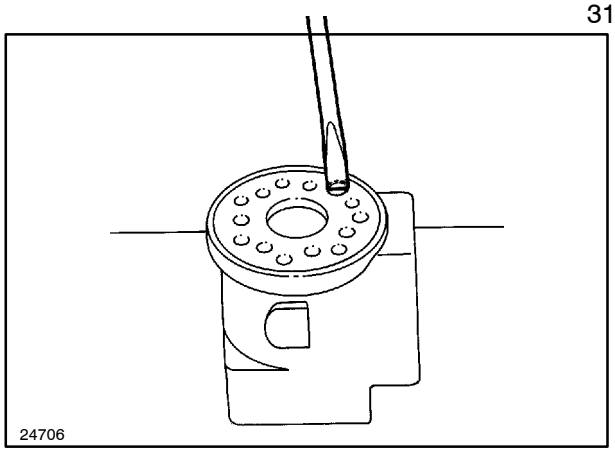
30

6. Extract the thrust washer.



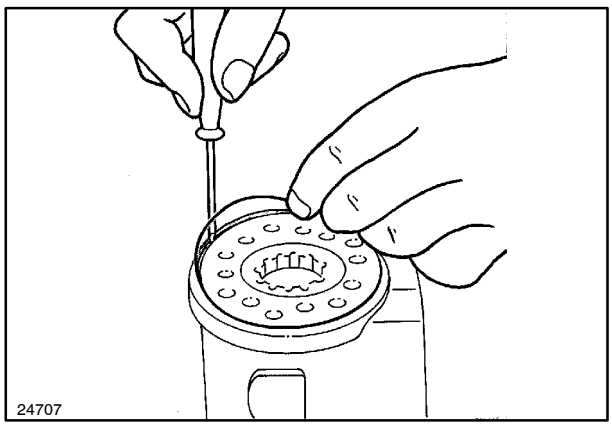
31

7. Remove the threaded plug on the non-return valve seat.



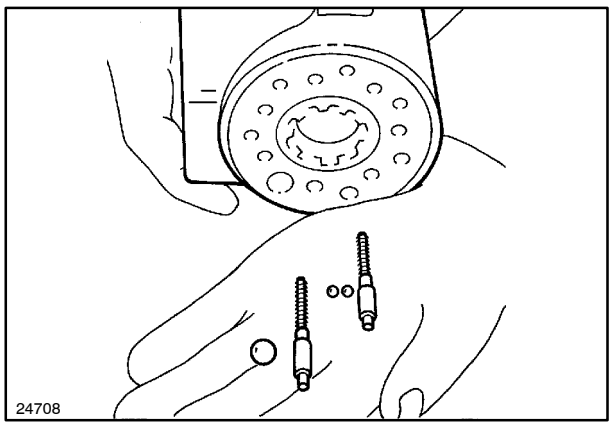
32

8. Extract the O-ring seal from the control valve body.



33

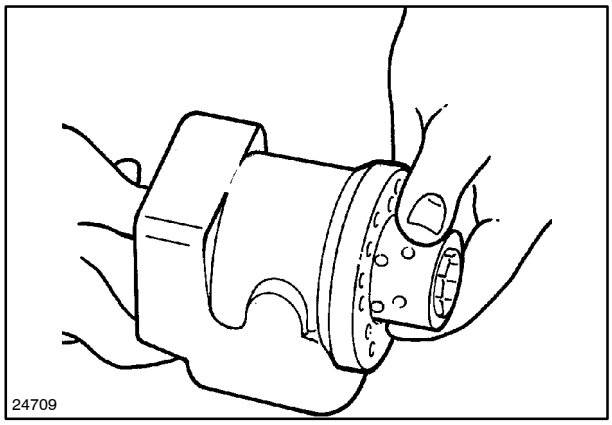
9. Rotate the control valve body and extract the non-return valve ball, the two balls with the relative pins and the backflow valve springs.



34

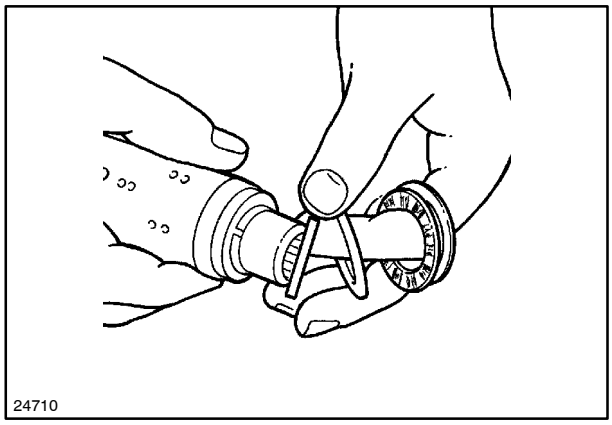
10. Position the control valve body and the rotor drive shaft so that the sleeve-control shaft trim pin is in a horizontal position.

11. Push the rotary valve inwards, so that the valve, the valve seat sleeve and the thrust bearing can be extracted from the control valve body.



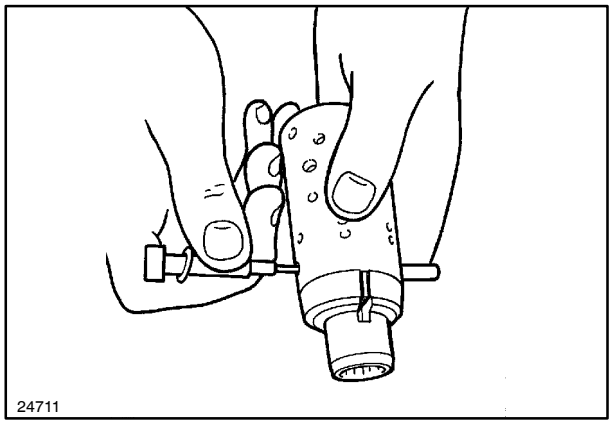
35

12. Extract the thrust bearing from the rotating valve, complete with the two external rings, and remove the spring retaining ring from the valve seat sleeve.



36

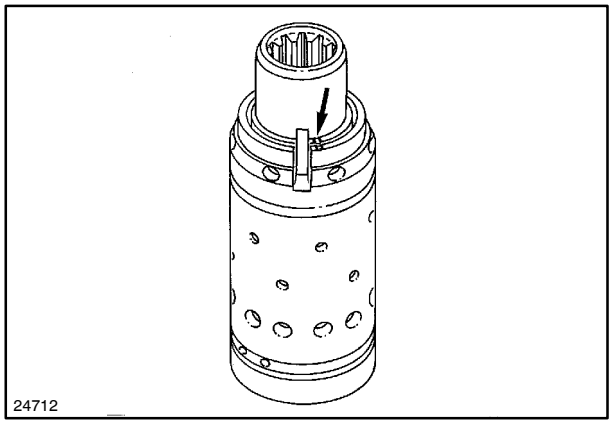
13. Extract the valve-sleeve trim pin.



37

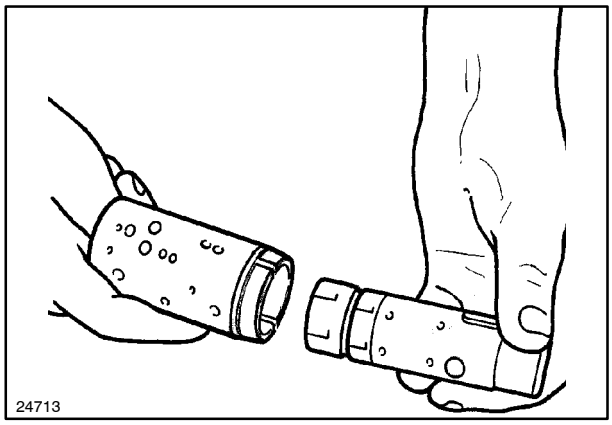
WARNING

On assembly, two reference marks were made on the rotating valve and the sleeve, corresponding to the neutral position maintained by the springs.
Before removing the springs, check that the marks are clearly visible, otherwise renew them.



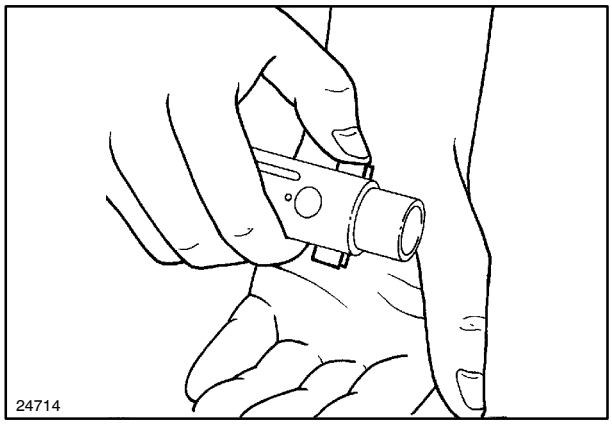
38

14. Extract the rotary valve from the valve seat sleeve.



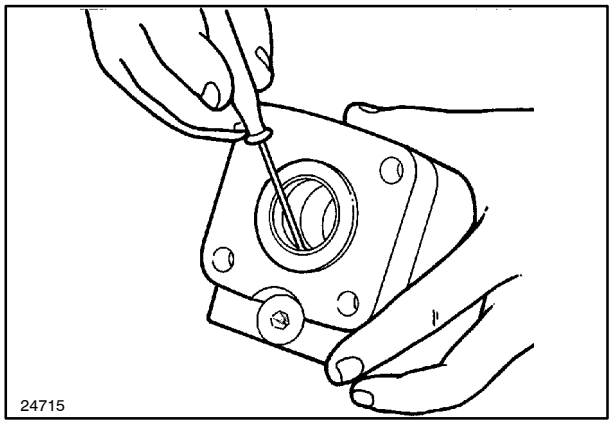
39

15. Remove the springs from the **neutral position**, extracting them from their seats.



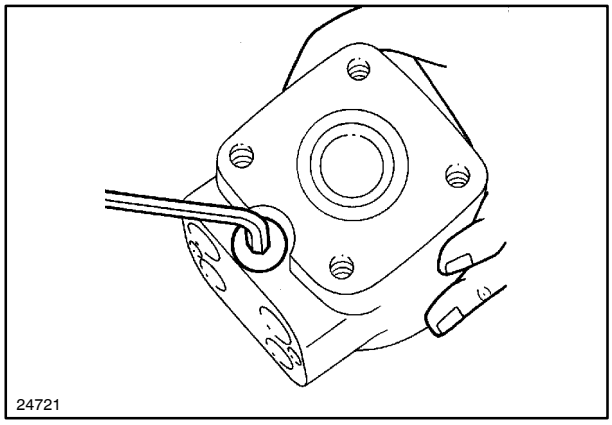
40

16. Remove the dust seal and the O-ring seal from their seats in the control valve body.



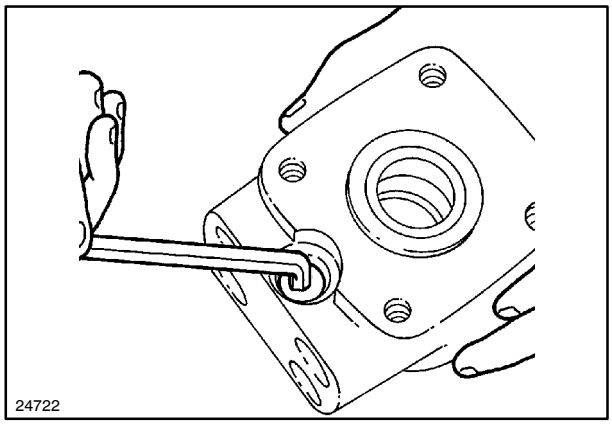
41

17. 0.2362 in. (6 mm) Allen wrench, remove the threaded plug on the pressure relief valve and extract the seal washer.



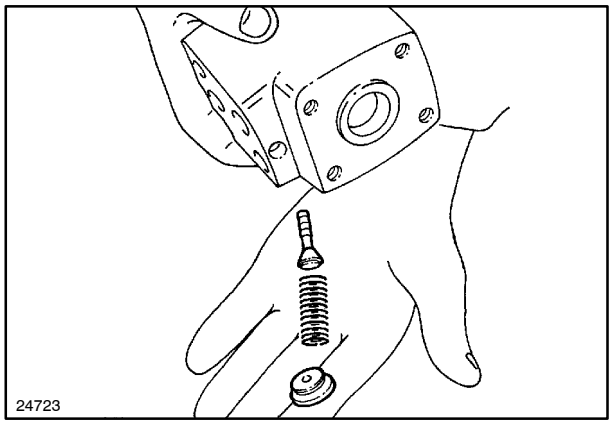
42

18. Remove the pressure relief valve adjuster screw.



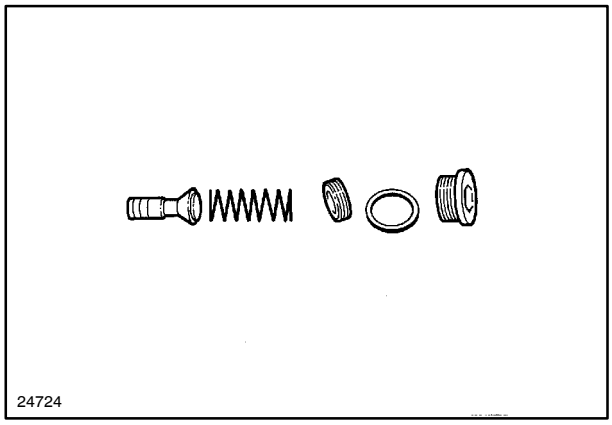
43

19. Turn the control valve body over and complete disassembly by extracting the spring and the pressure relief valve piston.



44

Pressure relief valve components (order of disassembly-assembly).



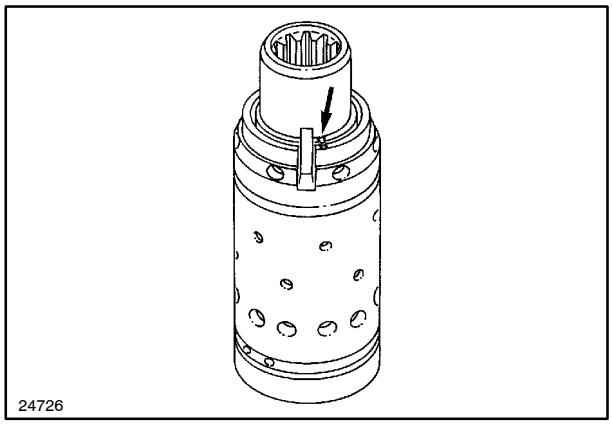
45

20. Thoroughly clean all control valve component parts.
21. Replace the washers and seals.
22. Carefully check all mechanical parts, replacing components that show signs of wear.
23. Before re-fitting, lubricate the components with hydraulic oil.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

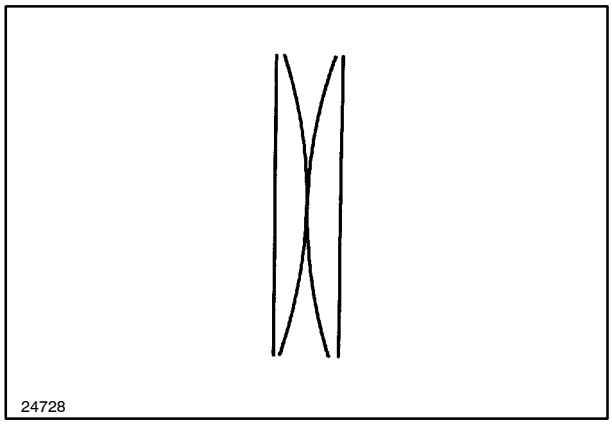
24. Re-fit the rotating valve on the sleeve, checking that the reference marks indicated in the drawing coincide.



46

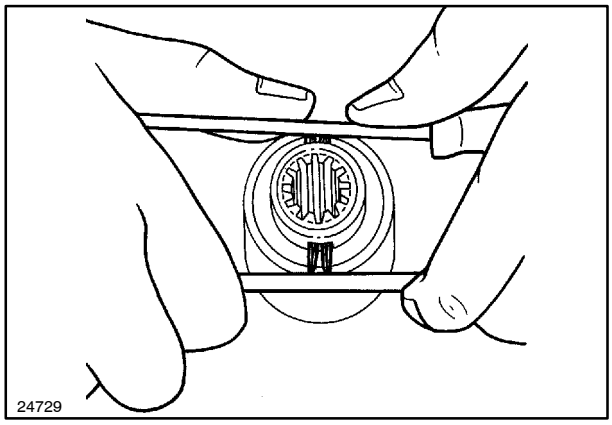
25. Use tool **380000306** to insert the flat and curved springs (11, fig. 2).

Diagram for fitting springs (11, fig. 2) **neutral** position for OSPC 100 ON-150N power steering.



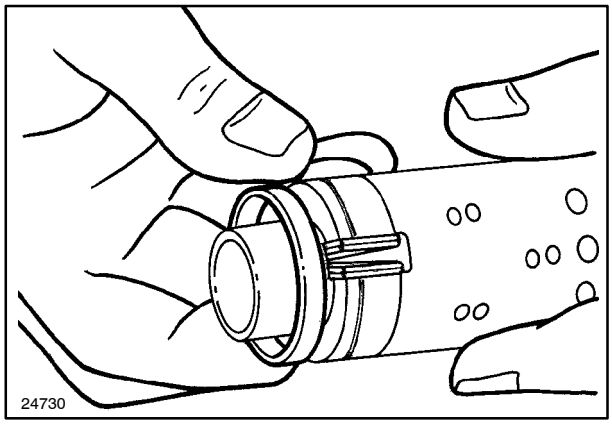
47

26. After inserting the springs in the seat, align and centre (as shown in the drawing).



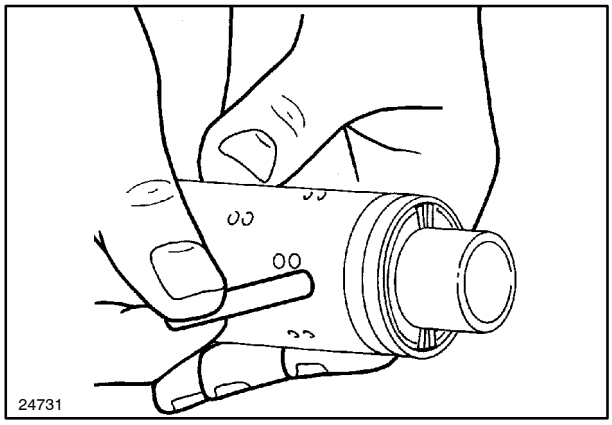
48

27. Fit the **neutral position** spring retaining ring on the valve seat sleeve, remembering that the ring must rotate freely without being impeded by the springs.



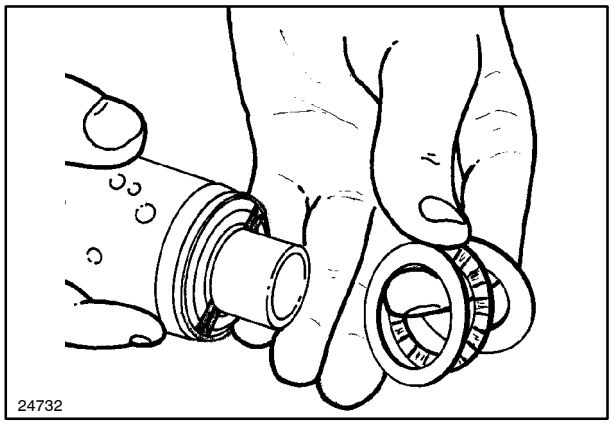
49

28. Insert the sleeve-rotor drive shaft trim pin.



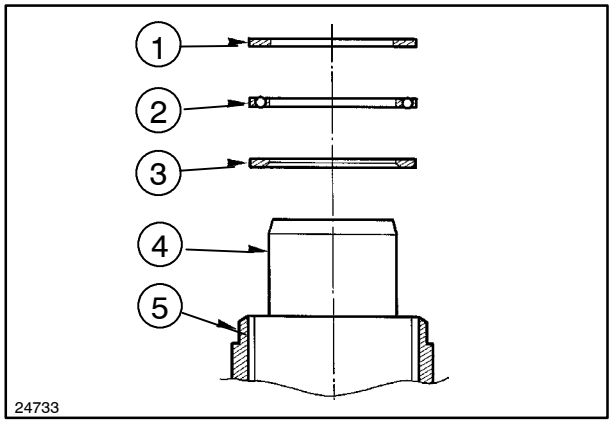
50

29. Fit the thrust bearing, following the order and indications shown in the drawing below.



51

1. Bearing external ring.
2. Thrust bearing.
3. Bearing internal ring with bevel facing the shim on part (5).
4. Rotating valve.
5. Rotating valve seat sleeve.



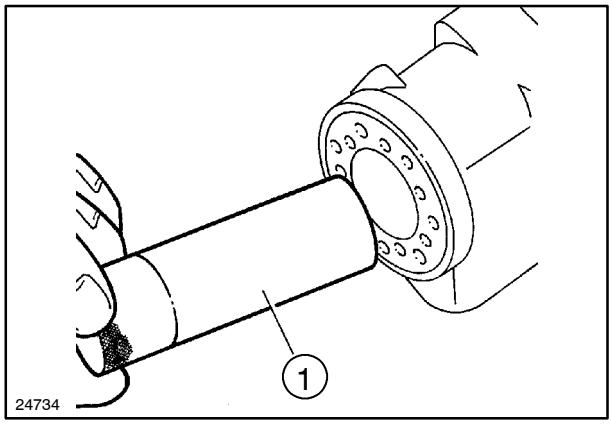
52

30. Position the control valve body so that the housing seat on the rotating valve sleeve is positioned horizontally, then insert the bush on guide (1) of tool:

380000305 (for **KIN-RING** seal)

OR

380000281 (for **ROTOGLYD** seal)



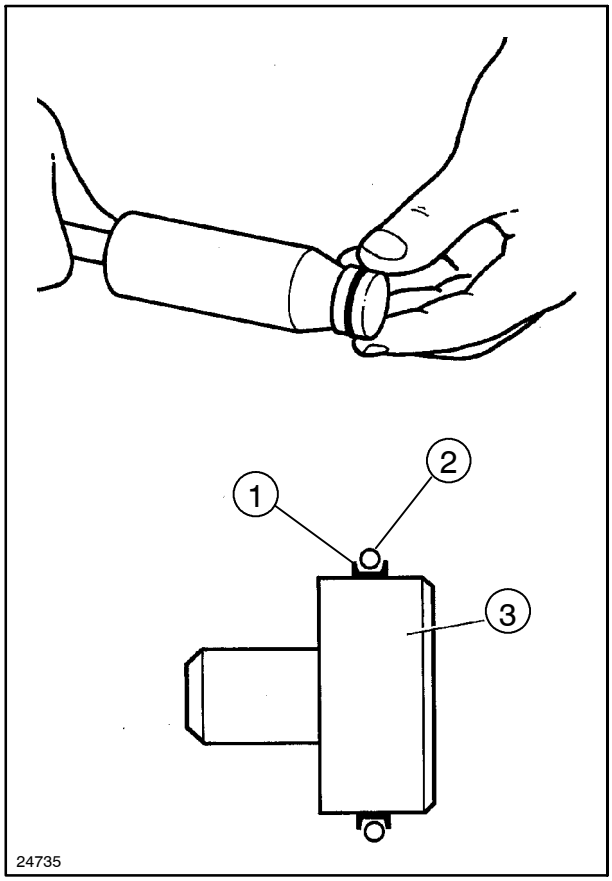
53

31. Lubricate the support rings (1), and seal rings (2) with hydraulic oil and assemble, as shown in the drawing, on the head (3) of tool:

    380000305 (for **KIN-RING** seals)

    OR

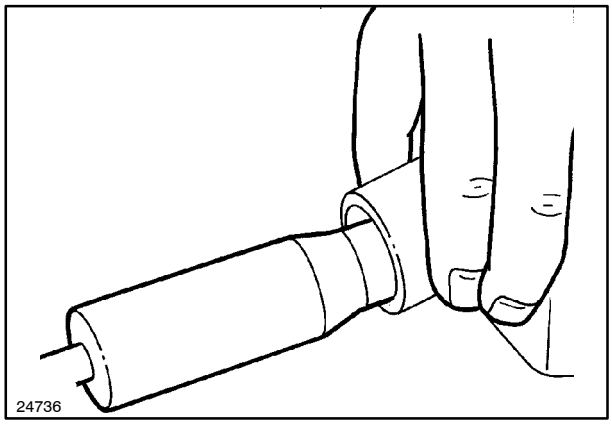
    380000281 (for **ROTOGLYD** seals)



Example of support head for fitting KIN-RING support and seal rings ▶
(part of tool 380000305)

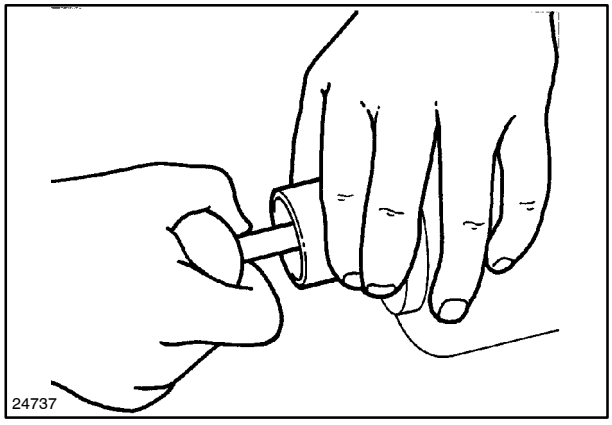
54

32. Insert the punch assembly in the previously installed guide bushing.



55

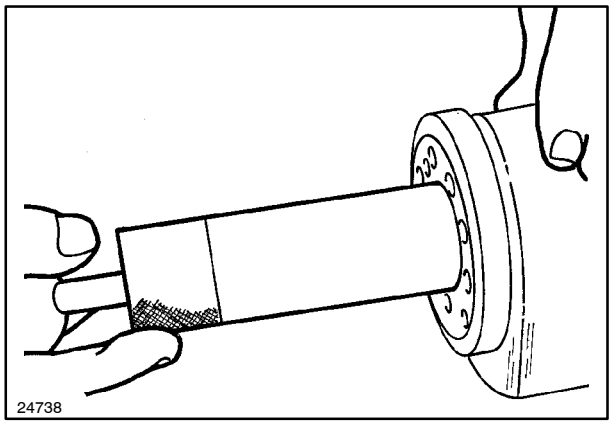
33. Whilst holding the external bushing with the hands, press fully down and simultaneously rotate the punch in order to facilitate the entry of the O-Ring in the control valve body seat.



56

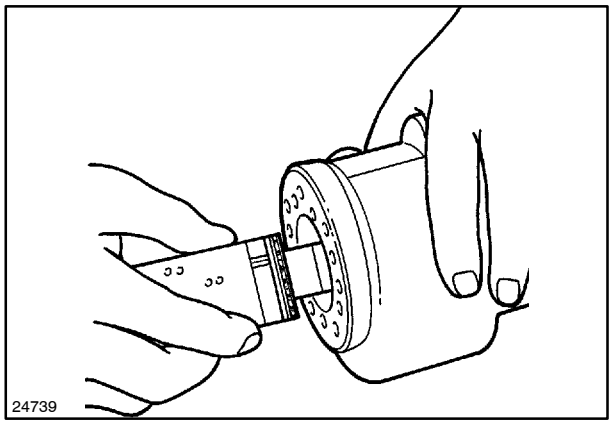
34. Extract the parts on tool **380000305**, or **380000281** (external bushing and punch).

    NOTE: *The support and seal ring support head remains on the control valve body (see fig. 54).*



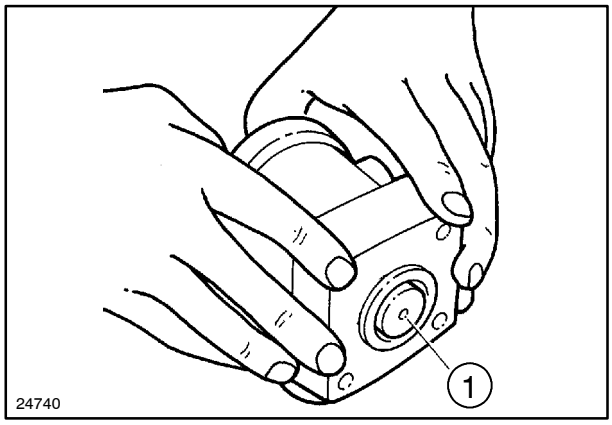
57

35. Insert the parts that were previously fitted, in operations 24 to 29, on the control valve body, holding the sleeve-rotor drive shaft trim pin in a horizontal position, to prevent it from slipping out and jamming in the slots inside the control valve body.



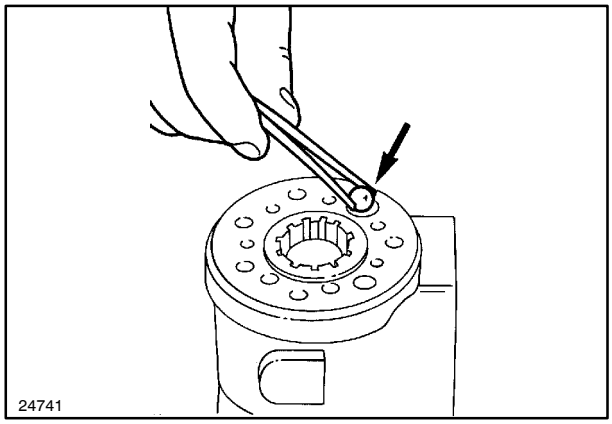
58

36. Press the rotating valve so as to bring the thrust bearing into contact with the control valve body; this will simultaneously expel the head (1) of tool **380000305** or **380000281** (see fig. 54) and insert the rings (1) and (2) on the control valve body seat (see operation 31).



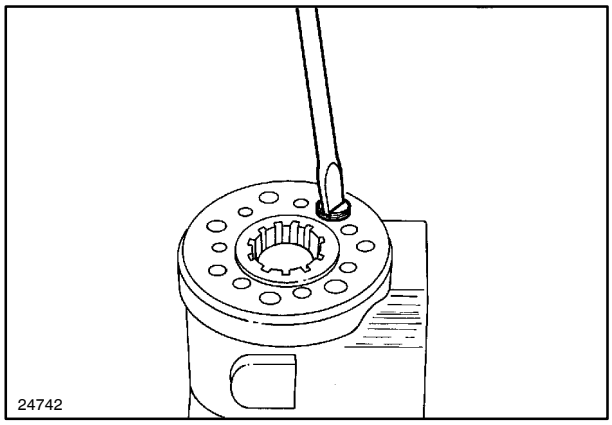
59

37. Rotate the control valve body and insert the non-return valve ball into the seat indicated by the arrow.



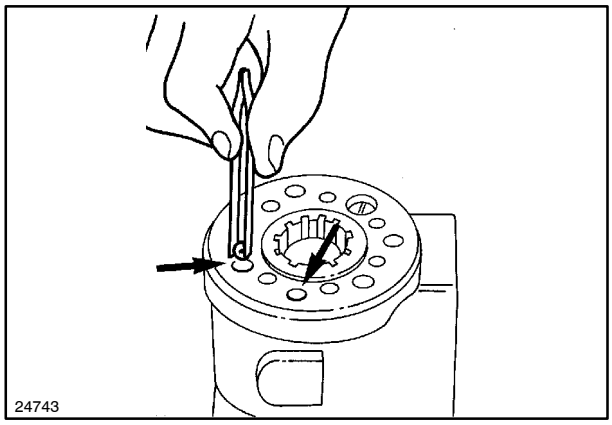
60

38. Screw the threaded plug into the non-return valve seat until the upper surface is below the coupling surface of the control valve body.



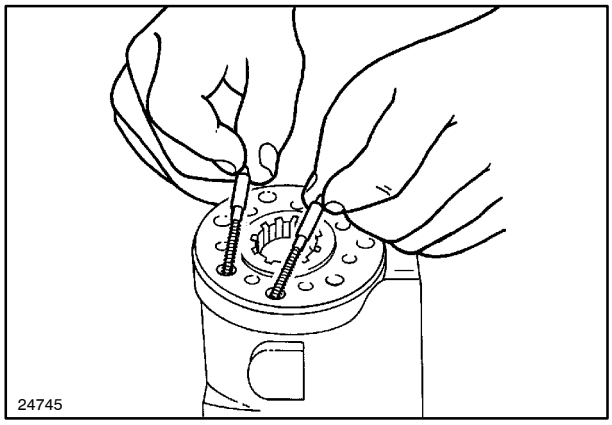
61

39. Insert the non-return valve balls into the two seats indicated by the arrows.



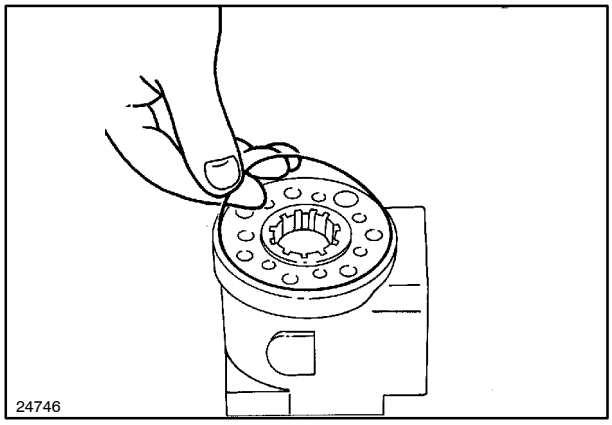
62

40. Position the pins, complete with springs, in the backflow valve seats indicated by the arrows (see fig. 62).



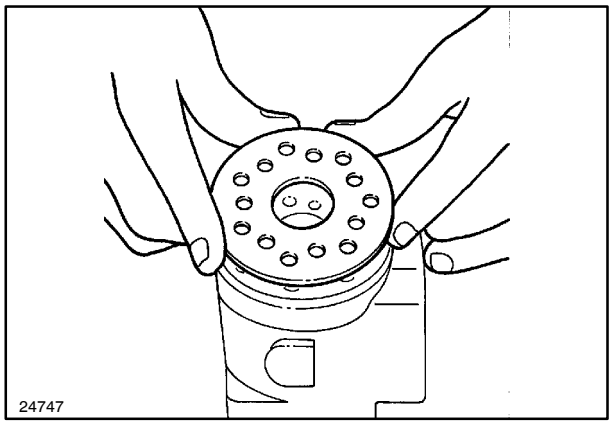
63

41. Lubricate the O-ring seal and insert in the seat on the control valve body.



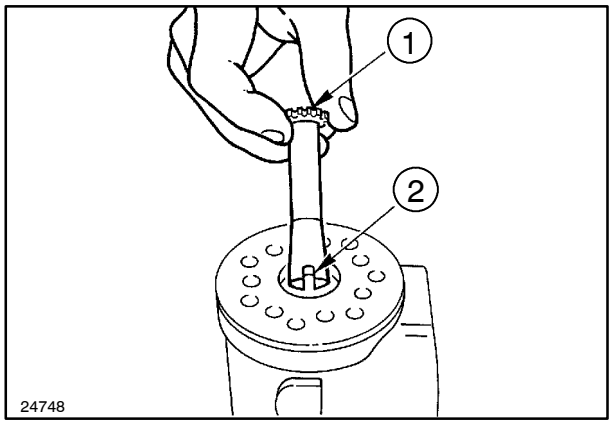
64

42. Fit the thrust washer, so that the holes coincide with the holes on the control valve body.



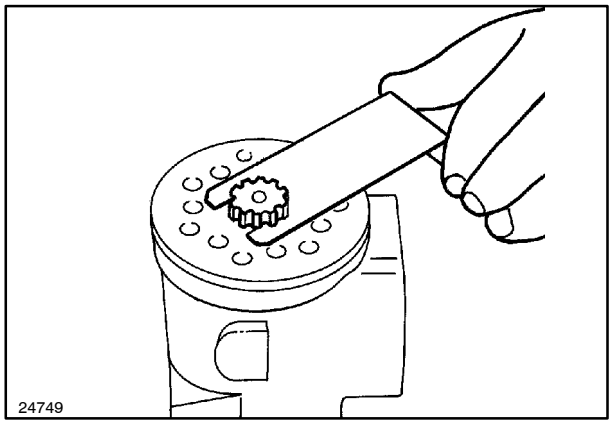
65

43. Make a reference mark on the upper part of the teeth (1), in line with the seat (2), to indicate the exact position of the valve-to-sleeve trim pin.



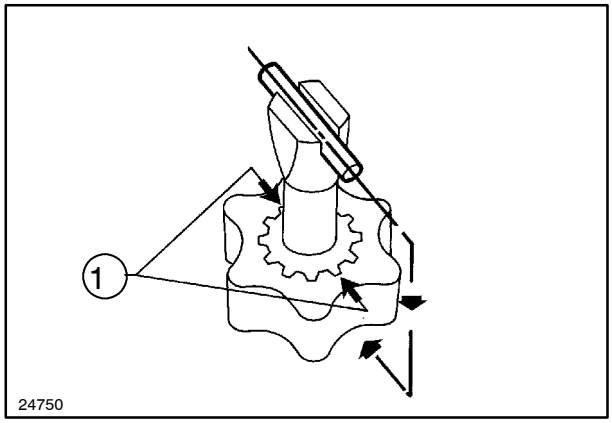
66

44. Fit the rotor drive shaft into the control valve body, insert tool **380000307** for retaining and centring the rotor drive shaft, between the rotor drive shaft and the thrust washer, rotating the shaft so as to facilitate coupling between the seat (2, fig. 66) and the trim pin installed on the sleeve.



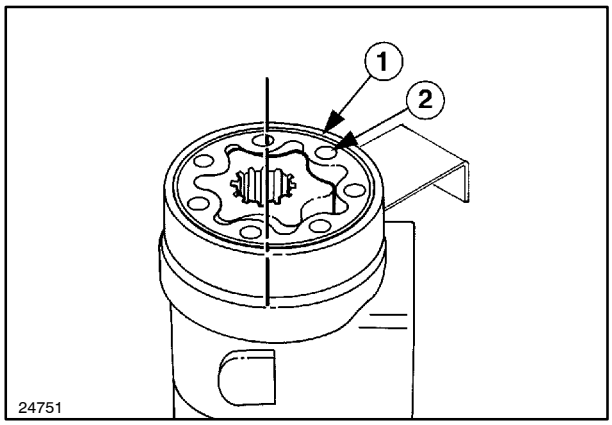
67

45. To re-fit the rotor, proceed as follows:
    a) each time the hydrostatic steering is disassembled, turn the rotor over so as to limit wear to the splined coupling;
    b) in the following drawing, the rotor shaft has been removed in order to show the timing between the rotor, rotor drive shaft and the trim pin;
    c) fit the rotor on the drive shaft, remembering that correct timing is obtained by aligning the teeth (1), on the trim pin axis plane (shown in drawing 66 with the centre line of one compartment on the rotor.



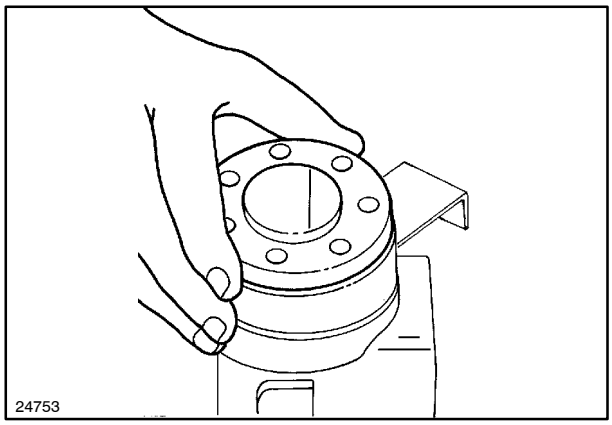
68

46. Lubricate the two O-ring seals (1) with hydraulic oil and insert them in the rotor fixed ring seat, fix in position by aligning the retaining holes (2) with those present on the thrust washer.



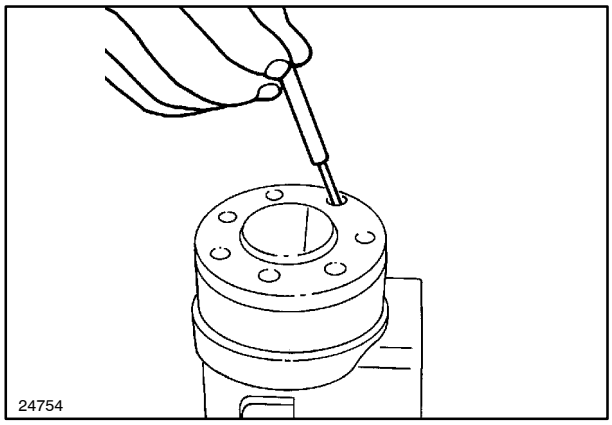
69

47. Fit the cover aligning the retaining holes with those present on the rotor fixed ring.



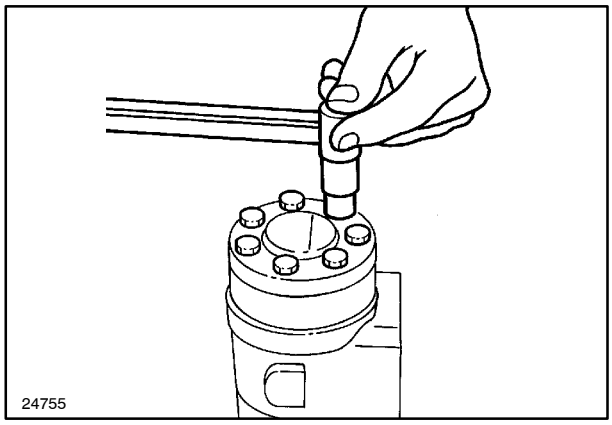
70

48. Remove retaining tool **380000307** and fit the special screw and washer in the non-return valve seat, shown in the drawing.



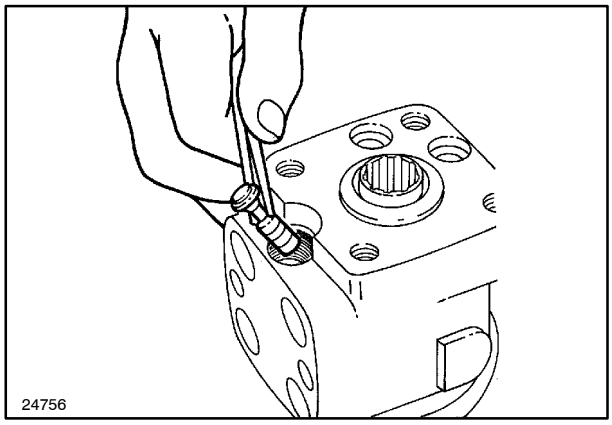
71

49. Fit the other six cover retaining bolts with the washers and tighten in diagonal sequence to the torque setting value shown in the table on page 4.



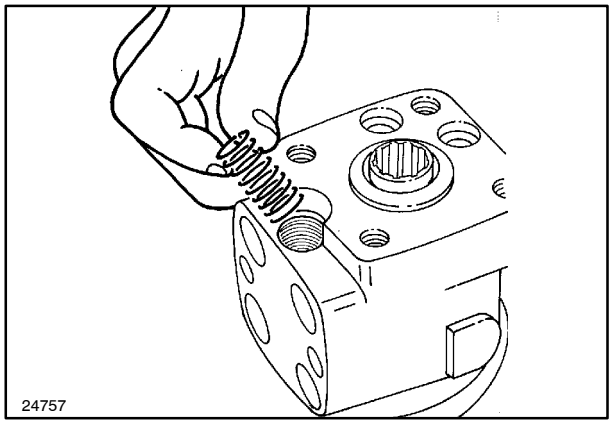
72

50. Turn over the control valve body and insert (see component details in fig. 45) the pressure relief valve piston in the seat indicated in the drawing.



73

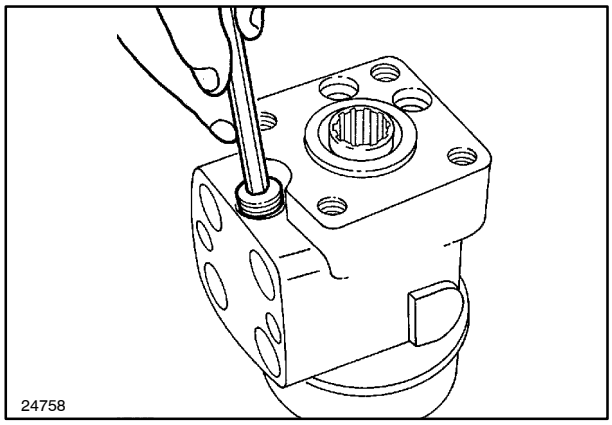
51. Insert the pressure relief valve spring.



74

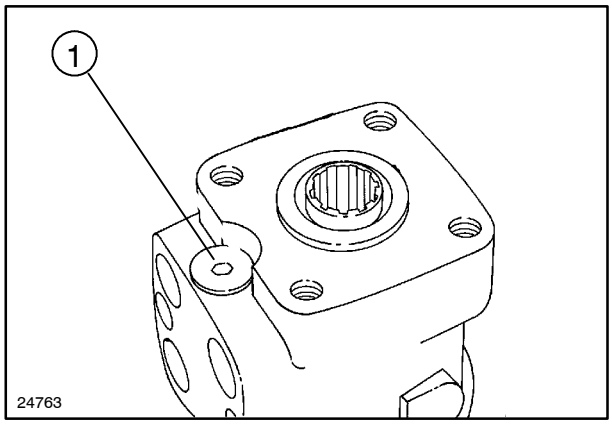
52. Using an 0.3149 in. (8 mm) Allen wrench, insert the pressure relief valve calibration screw.

NOTE: *Calibration will be carried out on the work-bench or on the tractor to the values shown in the table on page 2.*



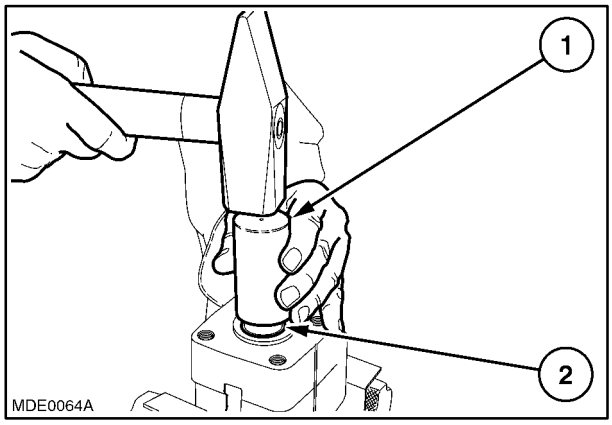
75

53. Tighten the plug (1) with the relative seal, using an 0.3149 in. (8 mm) Allen wrench, and tighten to the prescribed torque value of 40 to 60 Nm (4.1 to 6.1 kgm).



76

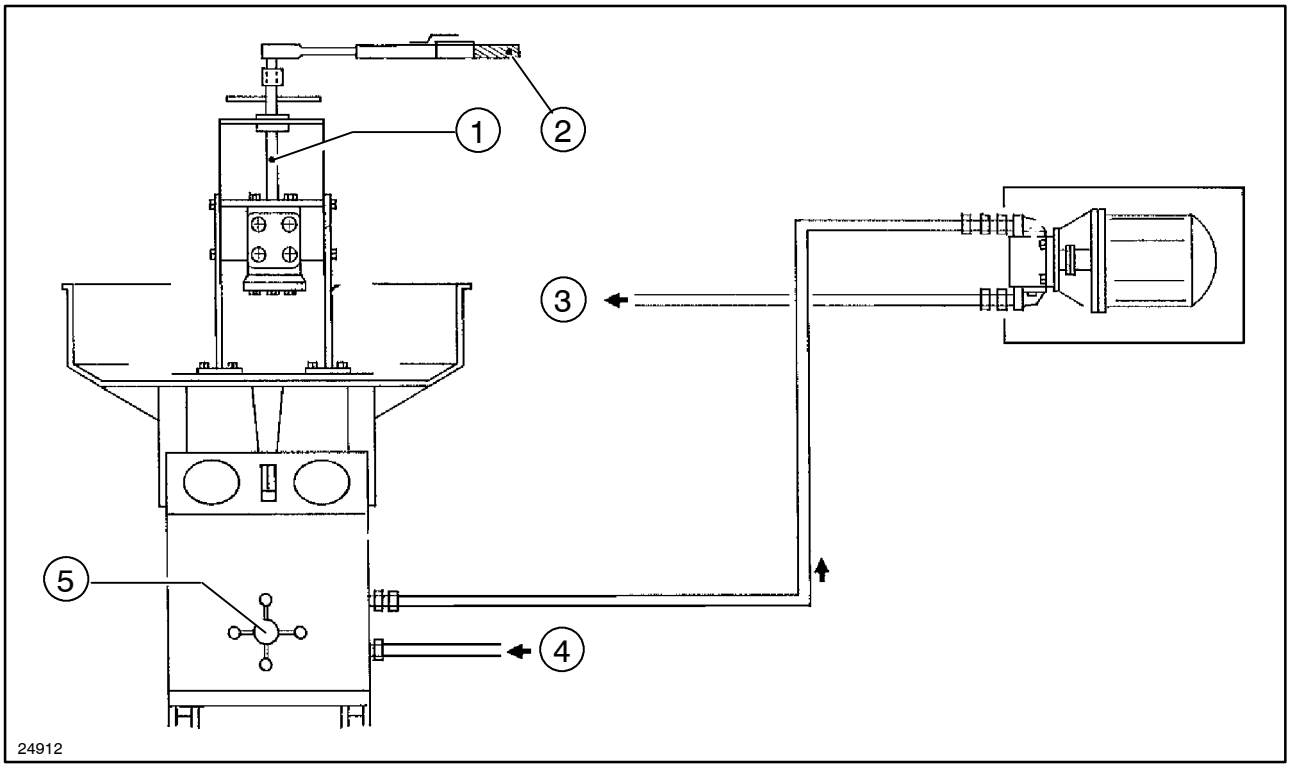
54. When the unit has been assembled, insert the dust ring seal (2) in the seat on the control valve body, using tool **380000210** (1).



77

0p. 41 204 38
HYDROSTATIC STEERING CONTROL VALVE
Bench test
Test conditions

Oil type .....
with **ISO VG 68, DIN 51524/51525** specifications (for outside temperatures of 0 °F to 122 °F (0 °C to 50 °C)]
Oil viscosity ..... SAE 20 W
Oil temperature ..... 140 °F (60 °C)
Hydraulic pump capacity ..... dm^3/min (l/min) 12
Electric motor speed ..... 1450 rpm



78

Diagram showing the installation of the tools and equipment required for the rotating valve, seals and pressure relief valve calibration test

1. Splined control shaft
2. Torque wrench
3. Delivery
4. Restriction
5. Pressure adjustment handwheel

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts. Wear suitable safety clothing – safety goggles, gloves and shoes.

A - CHECKING ROTATING VALVE WEAR

1. Make the connections shown fig. 78 and complete the circuit as in fig. 79. Using the splined drive shaft (1), hold the hydrostatic steering control valve in the steering position (right or left).
2. Using the handwheel (5), increase the circuit pressure to approach the pressure relief valve setting (page 2) without allowing the valve to intervene.
3. Apply a torque wrench (2) to the drive shaft (1) and tighten to a setting of approx. 34 Nm (3.5 Kgm), check that the rotating valve takes more than ten seconds to complete one full rotation. If less, replace the rotating valve (12, fig. 6) and relative sleeve (11).

B - CHECKING RETURN TO NEUTRAL POSITION

In the same test conditions as **A**, check that the rotating valve automatically returns to the neutral position when the drive shaft (1), is released after each simulated steering movement.

C - SEAL CHECK

In the same test conditions as **A**, hold the rotating valve in the steering position with the drive shaft (1) for approx. three minutes and check the seals for leaks.

D - PRESSURE RELIEF VALVE CALIBRATION

1. Make the connections as shown in the diagram in fig. 78 and complete the circuit as in the drawing 79.
2. Using the drive shaft (1) simulate a turn (to the left or to the right) so as to interrupt the oil flow to the discharge.
3. Gradually increase the in the circuit by turning the handwheel (5, fig. 78), and check on the pressure gauge that the pressure relief valve (22, fig. 2) is activated at the pressure shown on page 2, if not, increase or reduce the pressure relief valve setting by tightening or slackening the adjuster screw.

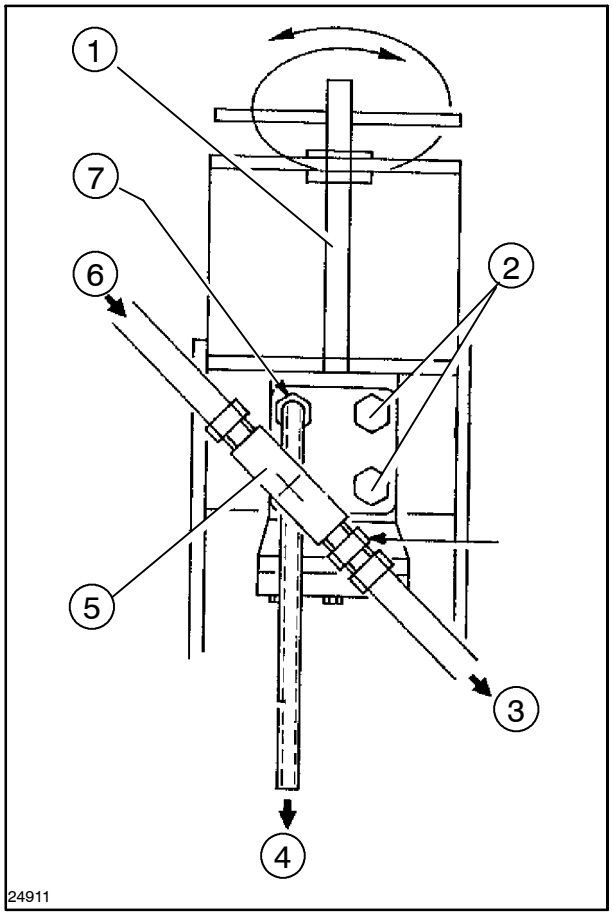
CHECKING THE HYDROSTATIC STEERING PRESSURE RELIEF VALVE WITH CONTROL VALVE INSTALLED ON TRACTOR.

Proceed as follows:

1. Start the engine and perform a few steering movements with the tractor, until the oil reaches a temperature of approx. 122 °F (50 °C).
2. Switch off the engine and detach the oil delivery pipe union (4) on the hydraulic cylinder (5).
3. Replace the original union with unions (2 and 3), and connect the pressure gauge (1) with a scale of 0 to 150 kg/cm^2 with kit **380000240**.
4. Start the engine again, bring the speed to medium rpm and apply full steering lock to bring the hydraulic cylinder to the stroke end position.

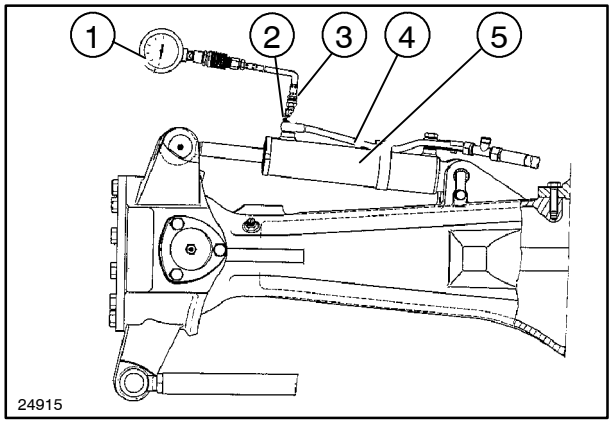
In this condition the pressure relief valve (22, fig. 2) should intervene, with the pressure gauge showing the value prescribed on page 2.

5. If the pressure is different, the valve (22) can be calibrated by means of the adjuster screw.



79

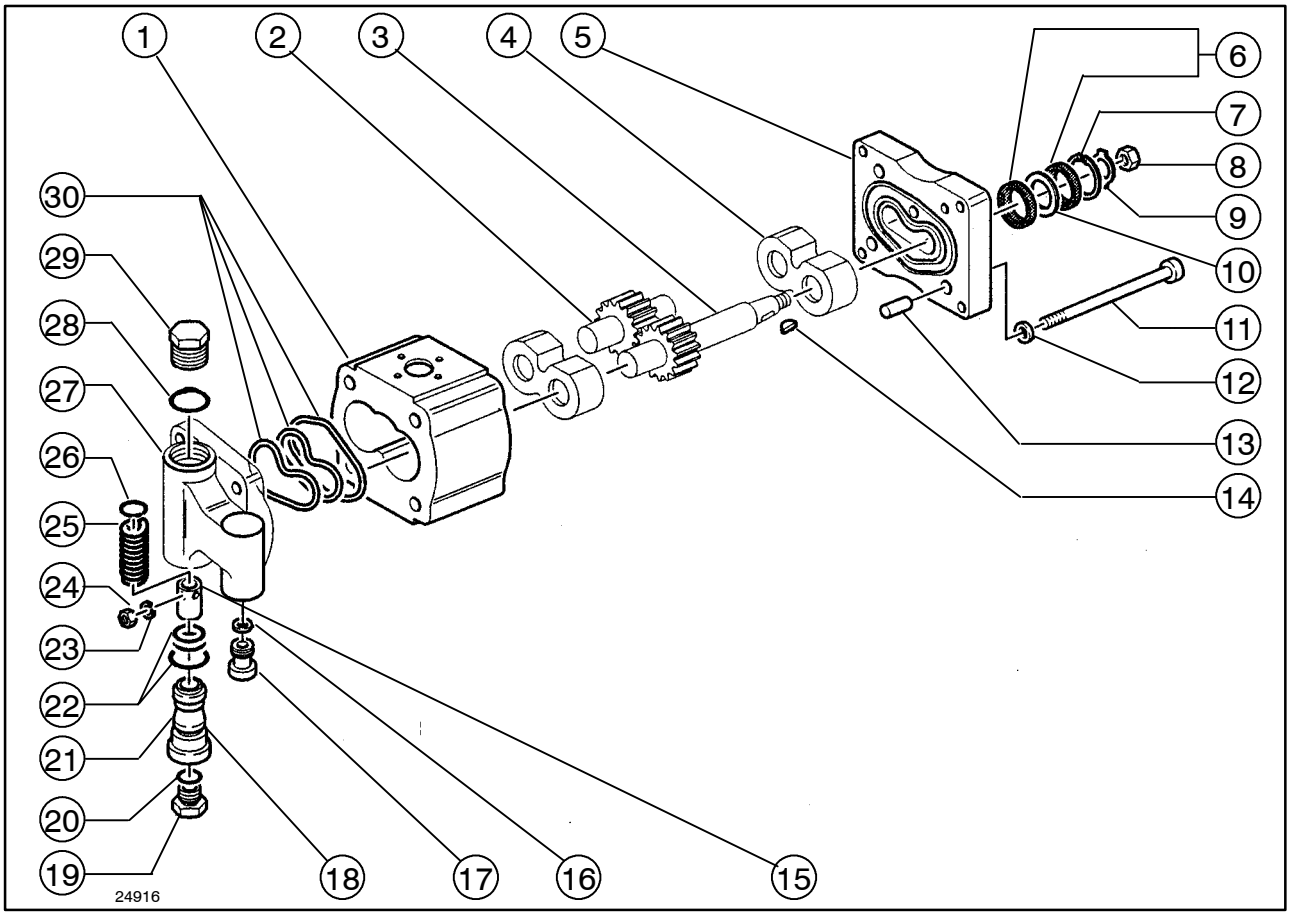
1. Splined control shaft - 2. Plug G 1/2" - 3. To the restriction - 4. Exhaust - 5. Three-way coupling G 1/2" - 6. From delivery line - 7. Discharge coupling G 1/2".



80

1. Pressure gauge supplied with kit **380000240** - 2. Union **293874** (supplied in kit **380000240**) to be fitted in the place of the original union - 3. Union **291318** (supplied with **380000240**) to be connected to the pressure gauge (1) - 4. Hydraulic cylinder oil delivery pipes - 5. Hydraulic cylinder.

0p. 41 206 20
HYDROSTATIC STEERING OIL PUMP D.A.
with the pump removed



81

Hydrostatic steering hydraulic pump components

1. Pump body
2. Driven gear shaft
3. Driving gear shaft
4. Gear support
5. Rear cover
6. Driving gear seals
7. Seal snap ring
8. Nut securing sleeve to pump shaft
9. Nut safety washer (8)
10. Spacer
11. Retaining bolt
12. Flat washer
13. Centering bushing
14. Tab
15. Cursor for seat (18)
16. Restrictor ring
17. Plug
18. Seat for cursor (15)
19. Plug
20. Seal
21. Seal
22. 'O' ring seal
23. Washer
24. Retaining nut
25. Spring
26. Ring
27. Front cover
28. Seal
29. Plug
30. Cover seal

1. Remove the retaining nuts (24) on covers (5 and 27), then the bolts (11) and the relative safety washers (23).
2. Remove the nut (8) that secures the sleeve to the pump driving shaft (3) and the safety washer (9).
3. Remove the retaining ring (7), rear cover (5) and seals (6).
4. Mark the parts (1), (2), (4), (5), in order to re-fit them in the same position, if in good condition.
5. Remove the supports (4) and the gears (2) and (3) from the rear cover (5) and the pump body (1).
6. Recover the seals and the anti-extrusion rings (30).
7. Remove the plugs (19 and 29) with the relative seals (28 and 20), remove the flow control components 15, 18, 21, 22, 25 and 26 from the body (27).

Once the parts are removed, proceed as follows:

8. Check that the gear contact surfaces are flat and perpendicular to their supports. Interpose a thin layer of carbon black; small rough spots can be removed using extremely fine and adequately lubricated abrasive paper.
9. Check that the distance 2, see figure alongside, is less than the distance 1 of 0.0039 to 0.0070 in. (0.100 to 0.180 mm) (end float of the support-gear assembly).

If necessary, true the flat surfaces involved using lubricated abrasive paper to remove extremely small quantities of material.

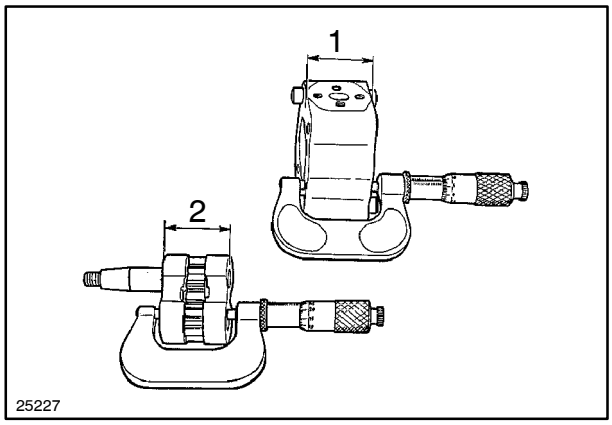
10. Clean all constituent parts thoroughly.
11. In the event of oil leaks, replace the seals.
12. Lubricate the parts with the same oil used in the system and refit the pump by referring to fig. 81, proceeding as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

a) Reverse the preceding operations starting from no. 7 to no. 1;
b) always ensure maximum cleanliness to prevent foreign matter from entering and damaging the pump;
c) fit together the previously marked parts (1), (2), (4), (5) referring to operation 4, in the original positions;
d) mount the gear supports (4) by hand in the pump body, positioning the unions on the external circumference facing towards the delivery passage, moving the front face flush with the gears (2 and 3);
e) insert the plastic anti-extrusion ring and the O-ring seals on the front (27) and rear (25) covers;
f) fit the seals (6), on the rear cover (5) complete with the spacer (10) and fill the space between the seal lips with **AMBRA GR9 grease**.

13. Refit the pump on the tractor and fill the intake line and pump body with **AMBRA MULTI G** oil, in order to facilitate priming and to avoid seizure during the initial operating period.



82

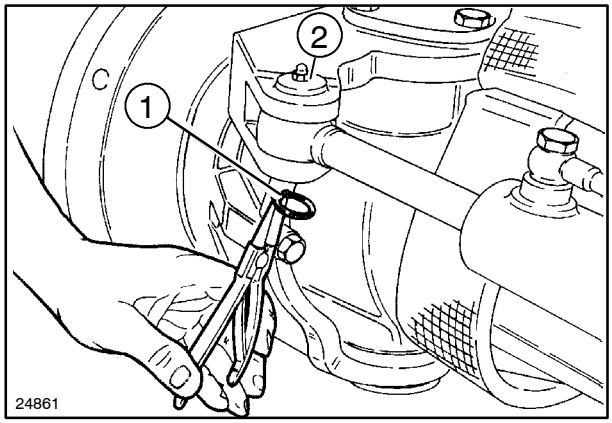
0p. 41 216 10
FRONT AXLE STEERING CYLINDER D.I.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

To remove the steering cylinder from the front axle, proceed as follows:

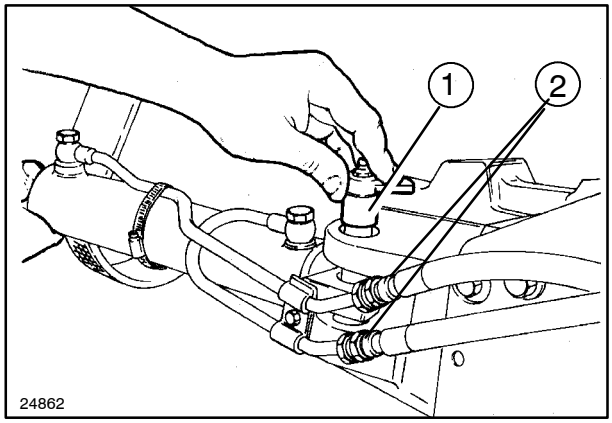
1. Remove the snap ring (1) and the pivot pin (2) on the cylinder rod/stub axle casing.



83

2. Unscrew the connecting unions (2) on the power steering/cylinder delivery and return lines.

3. Unscrew the grub screw and the pin (1) securing the cylinder to the axle body, then remove the cylinder.



84

NOTE: *If both cylinders and feed lines need to be removed, do not carry out the previously described operation 3, and repeat operations 2 and 4 on the other cylinder.*

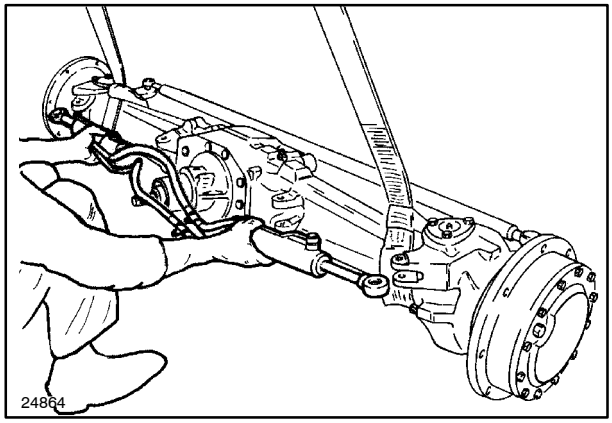
4. Remove both cylinders and feed lines.

5. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

6. Perform the above-described operations in reverse order.



85

0p. 41 216 20
FRONT AXLE STEERING CYLINDER R.I.

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

To remove the axle steering cylinder, proceed as follows:

1. Remove the exhaust pipe, raise the bonnet.

2. Unscrew the pipe unions (1, fig. 86) for the cylinder oil delivery and return line (2).

3. Unscrew the nut securing the cylinder rod articulated head to the lever (1, fig. 87).

4. Using the extractor (1) separate the articulated head from the cylinder rod.

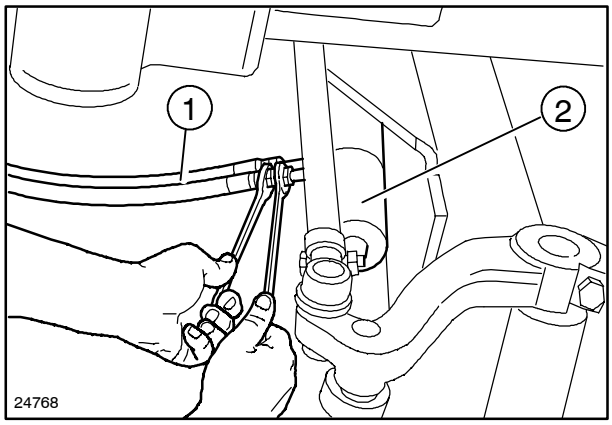
5. Remove the pin securing the cylinder to the axle body and remove the cylinder (1).

6. To assemble, proceed as follows:

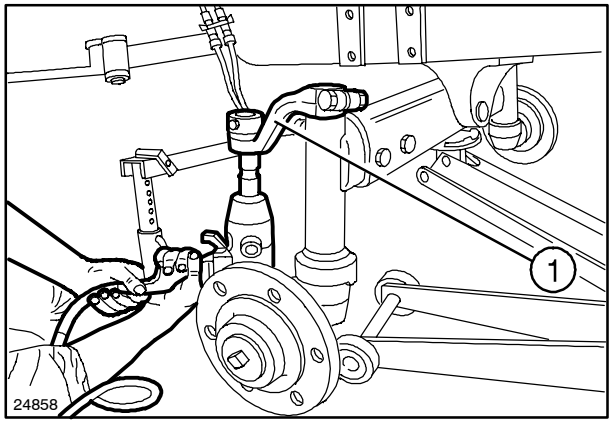
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

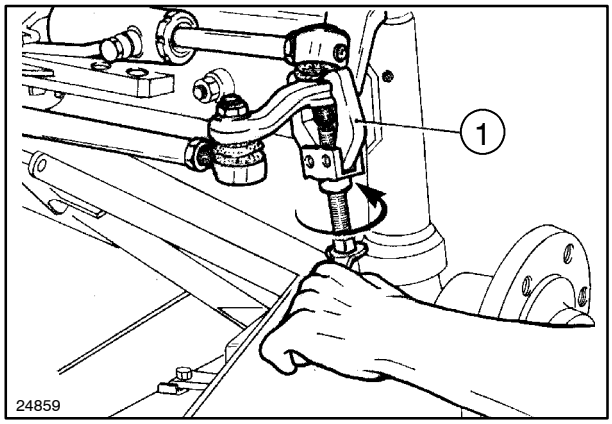
7. Perform the above-described operations in reverse order.



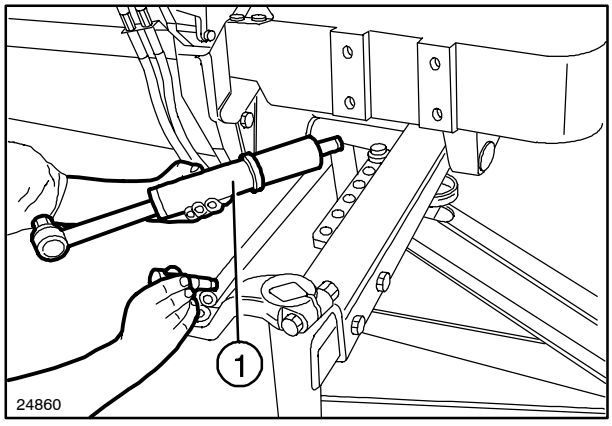
86



87



88



89

SECTION 44 - AXLES AND WHEELS

Chapter 1 - Axles and wheels

CONTENTS

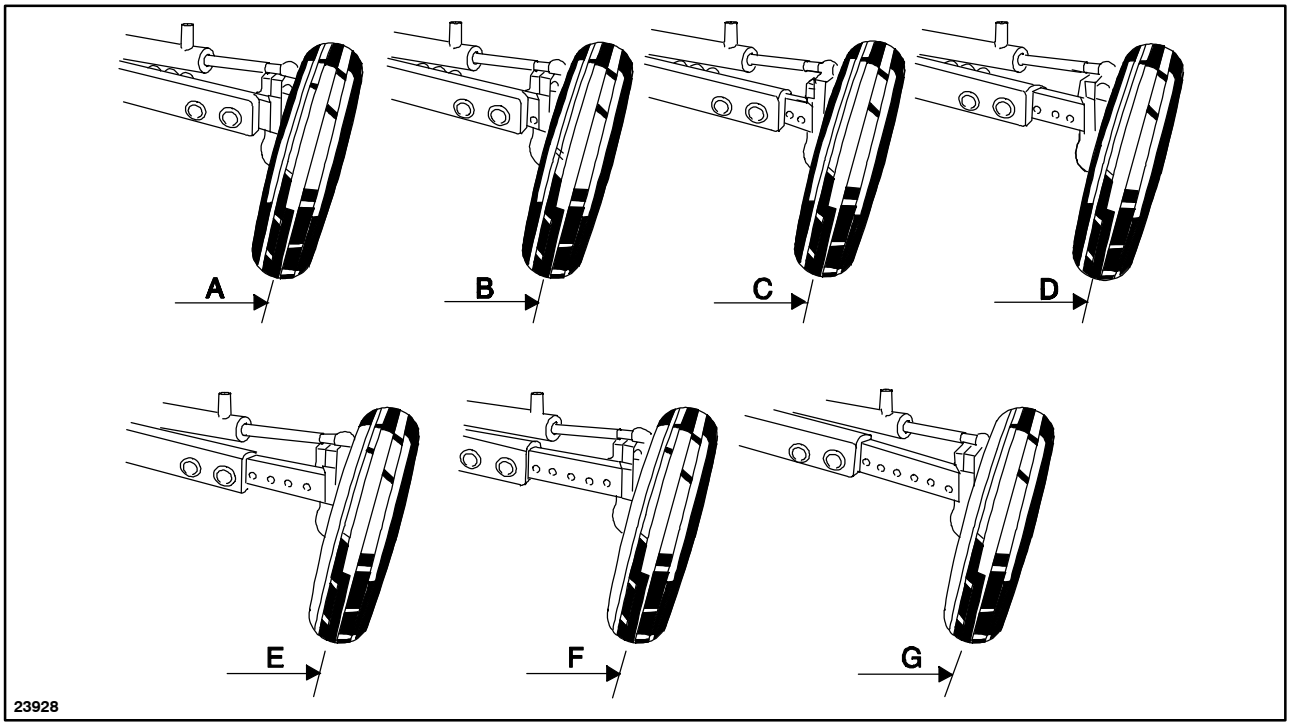
Operation	Description	Page
	Data	1
	Cross-sectional views	3
	Tightening Torques	4
	Fault diagnosis and equipment	5
44 101 22	Front axle hub D. A.	6
44 101 30	Front axle R.I.	9
44 101 46	Stub axle Overhaul	12
44 511 80	Checking 2 WD front wheel camber and toe-in	15
44 511 80	Checking 4 WD front wheel alignment	16

DATA

Type		inverted U-section, telescopic and oscillating at centre
Camber angle	in (mm)	2°, corresponding to approx. 0.5905 in. (15 mm) for 16" rims"
Toe-in	in (mm)	0 to 0.1968 in. (0 to 5)
Stub axle articulation		
Diameter of stub axle pin (7, fig. 2) at bushings (6)	in (mm)	1.4945 to 1.4960 (37.961 to 38.000)
Internal diameter of fitted bushings (6)	"	1.4980 to 1.5015 (38.050 to 38.140) (*)
Clearance between stub axle pin and bushings	"	0.0019 to 0.0070 (0.050 to 0.179)
Axle articulation		
Diameter of articulation pivot (1, fig. 2)	in (mm)	1.4945 to 1.4960 (37.961 to 38.000)
Internal diameter of fitted bushings (2)	"	1.4980 to 1.5015 (38.050 to 38.140) (*)
Clearance between stub axle pin and bushings	"	0.0019 to 0.0070 (0.050 to 0.179)

(*) Value to be obtained without refacing.

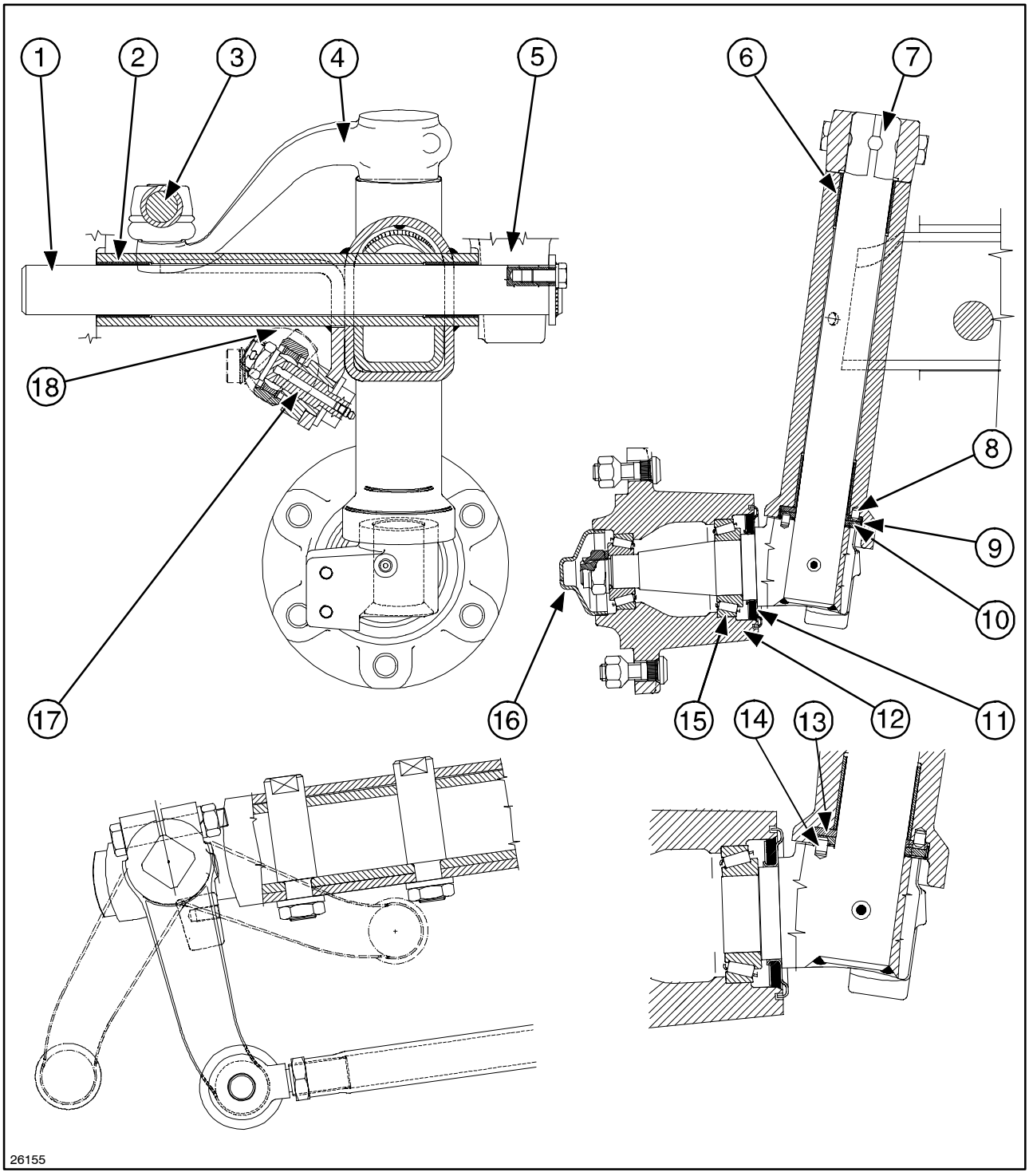
2WD FRONT WHEEL TRACK DIAGRAM



1

Models	tyres	Standard wheel tracks	Wheel tracks							
			A	B	C	D	E	F	G	H
TL70	6.00-16	1507	1407	1507	1607	1707	1807	1907	2007	2175
	7.50-16	1524	1424	1524	1624	1724	1824	1924	2024	2157
TL80 TL90 TL100	7.50-16									
	7.50-18									
	7.50-20									
	9.00-16	1615	1515	1615	1715	1815	1915	2015	2115	-
	10.00-16									

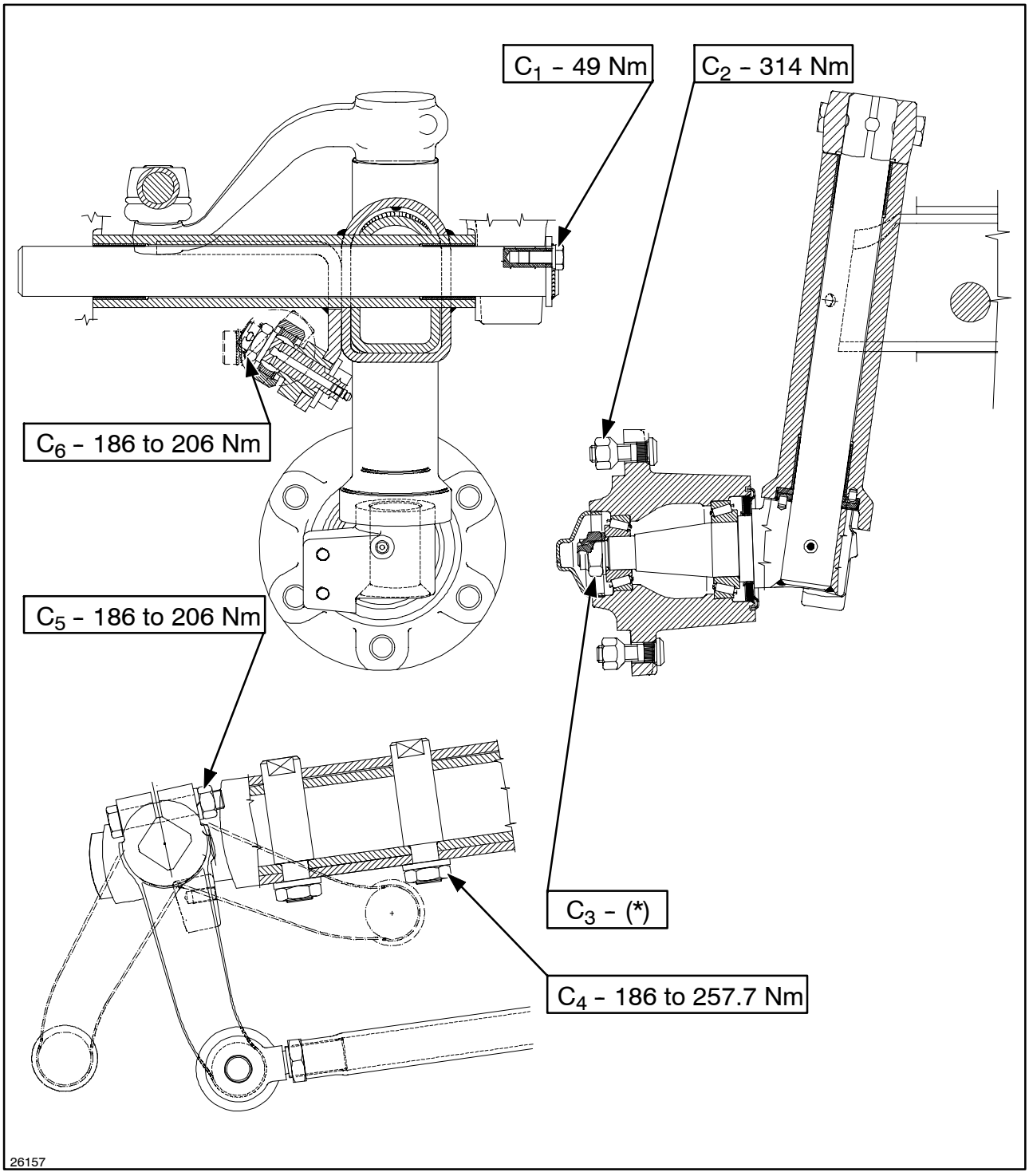
9.00-16 and 10.00-16 tyres are fitted with rim facing outwards. By reversing the rim on other tyres maximum track **H** is obtained, as in the table.



2

Sectional views of the stub axle, articulation pin and front axle

1. Axle articulation pin
2. Axle articulation bushings
3. Steering transverse tie rod
4. Stub axle pin control lever
5. Axle support
6. Bushings
7. Stub axle pin
8. Support ring grub screw (13)
9. Cup
10. Bronze thrust ring
11. Seal
12. Wheel Hub
13. Steel thrust ring
14. Grub screw for cap (11) and thrust washer (12)
15. Tapered roller bearings for wheel
16. Cover for greasing and adjusting the bearings
17. Cylinder fulcrum pin (18)
18. Power steering cylinder installation position



3

Front axle torque settings

C1 Axle pivot pin retaining bolt

C2 Disk to hub retaining bolt

C3 Bearings adjuster nut

C4 Axle end retaining nut

C5 Stub axle pin control lever retaining bolt nut

C6 Nut securing cylinder to fulcrum pin

***** See operations 12 and 13, page 8

TIGHTENING TORQUES

PARTS TO BE TIGHTENED	Thread	Tightening torque	
		Nm	kgm
Front Axle			
Bolt retaining axle support to engine	M 18 x 1.5	353	36
Stub head locknut for steering transverse tie-rod	M 16 x 1.5	102 to 123.5	10.4 to 12.6
Locknut for steering transverse tie-rod	M 20 x 1	176	18
Axle articulation pin retaining bolt (C_1, fig. 3)	M 10 x 1.25	49	5
Nut (C_2) securing leading wheel to hub	M 18 x 1.5	314	32
Nut (C_3) for bearing adjustment	M 20 x 1.5	(*)	(*)
Nut (C_4) for pin securing end of axle	M 20 x 1.5	186 to 257.7	19 to 26.3
Nut (C_5) for stub axles left and right-hand lever retaining bolt	M 14 x 1.5	186 to 206	19 to 21
Nut (C_6) securing cylinder to fulcrum pin	M 18 x 1.5	186 to 206	19 to 21

(*) See operations 12 and 13, page 8

TOOLS

WARNING

The operations described in this section can only be carried out with the **ESSENTIAL** tools indicated by an **(X)**. To work safely and efficiently and obtain the best results, it is also necessary to use the recommended specific tools listed below and certain other tools, which are to be made according to the drawings included in this manual.

List of specific tools required for the various operations described in this Section.

380000237 Wheel lifting hook.

FAULT DIAGNOSIS

Problems	Possible Causes	Solutions
Abnormal tyre wear.	1. Incorrect tyre pressure.	Inflate the tyres to the correct pressure, referring to the recommended pressures in the Use and Maintenance handbook, and the pressures indicated by the tyre manufacturers.
	2. Incorrect front wheel toe-in.	Correct the toe-in.
Poor stability of tractor.	1. Incorrect tyre pressure.	Inflate the tyres correctly as detailed above.

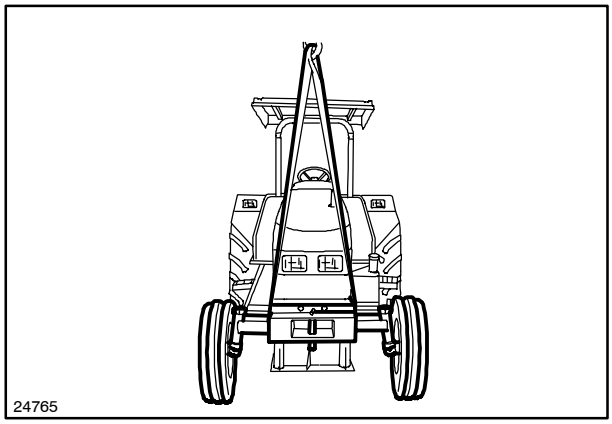
Op. 44 101 22
FRONT AXLE HUB D. A.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

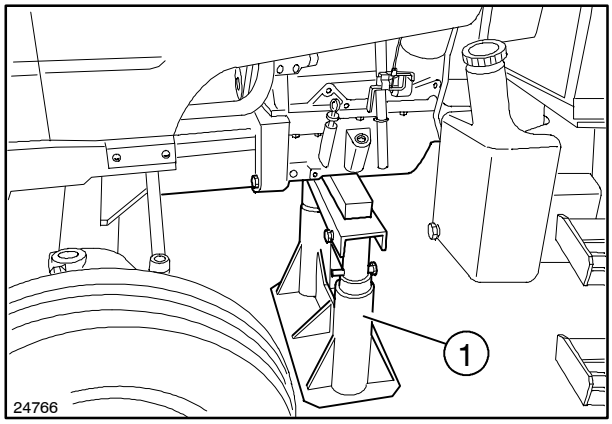
The wheel hubs can be removed without removing the axle from the tractor, proceeding as follows for each wheel:

1. Lock the rear wheels using suitable chocks.
2. Lift the front of the tractor.



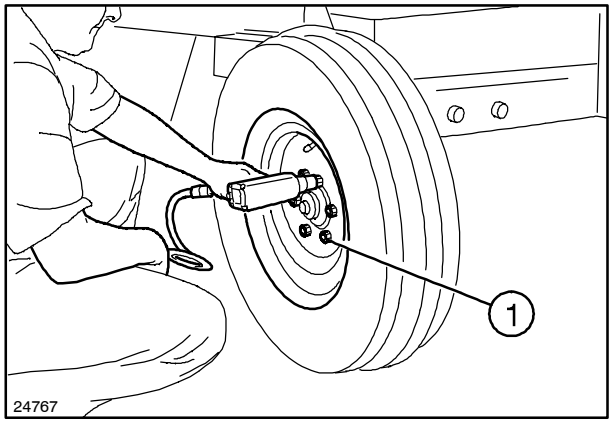
4

3. Place a mechanical stand (1) under the engine sump and insert a wooden block between the engine sump and the stand.



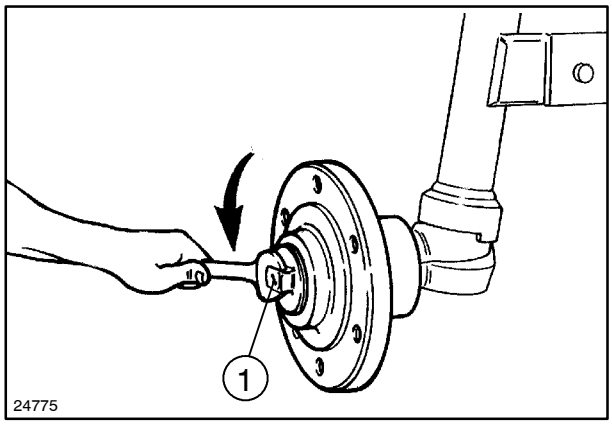
5

4. Remove the front wheel retaining bolts (1).



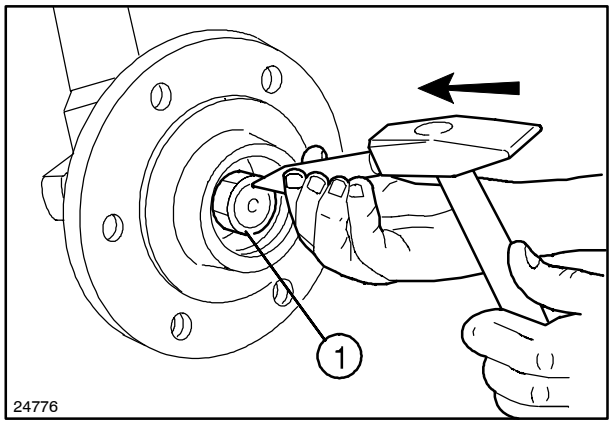
6

5. Remove the cover (1) for wheel hub bearing greasing.



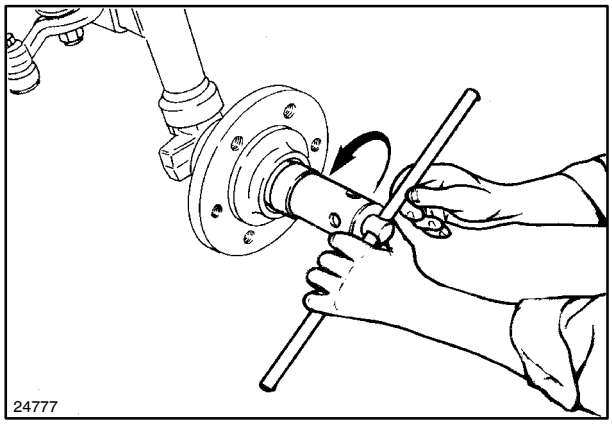
7

6. Remove the wheel hub bearing adjuster nut securing ring (1).



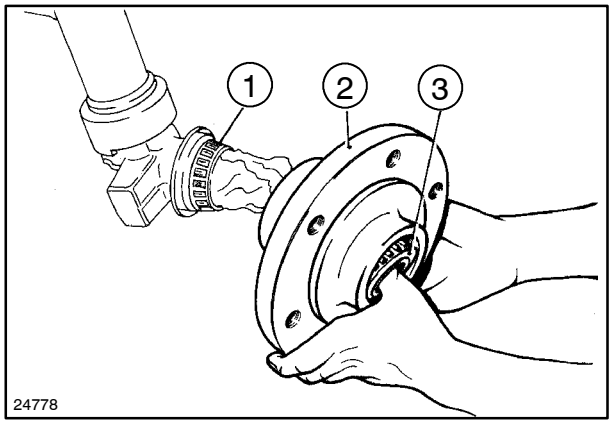
8

7. Using a socket wrench, unscrew the wheel hub bearing adjuster nut.



9

8. Remove the wheel hub (2) and recover the bearings (1 and 3).



10

9. To assemble, proceed as follows:

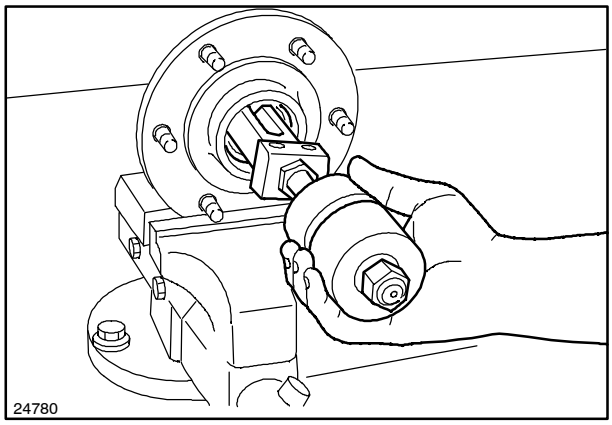
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

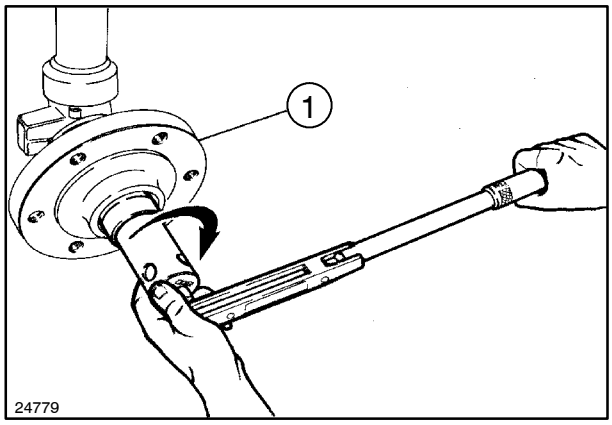
- Check and replace any worn bearings or faulty seals, using suitable pullers and punches.
- Fill the wheel hub with **AMBRA GR9 grease**.
- Refit the wheel hub, complete with bearings.
- Using a torque wrench, tighten the nut to a torque of 98 Nm (10 kgm), whilst rotating the wheel hub (1) to correctly seat the bearings.
- Loosen the nut, then tighten again to a torque of 24 to 29 Nm (2,5 to 3 kgm), whilst continuing to rotate the wheel hub.

NOTE: *The nut must be replaced each time the wheel hub is fitted.*

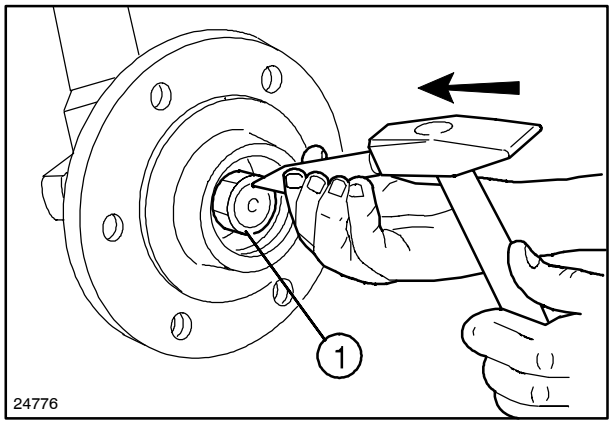
- Check the rolling torque R, bearing in mind that: R ≤ 0.8 kgm.
- Secure the nut (1) by notching.
- Refit the cover for wheel hub bearing greasing.



11



12



13

Op. 44 101 30
FRONT AXLE R.I.

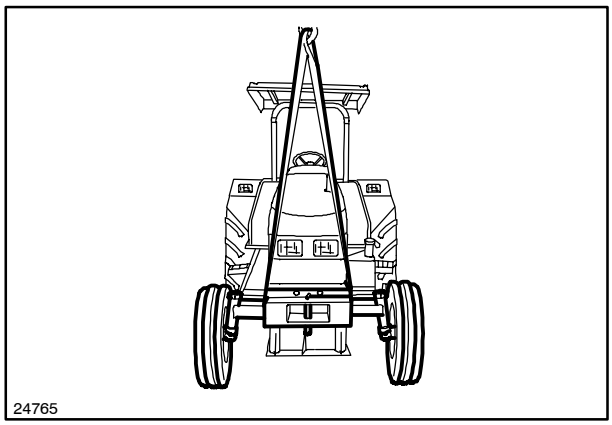
DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks.
Check that no one is in the vicinity of the load to be lifted.

To remove the front axle assembly from the tractor, proceed as follows:

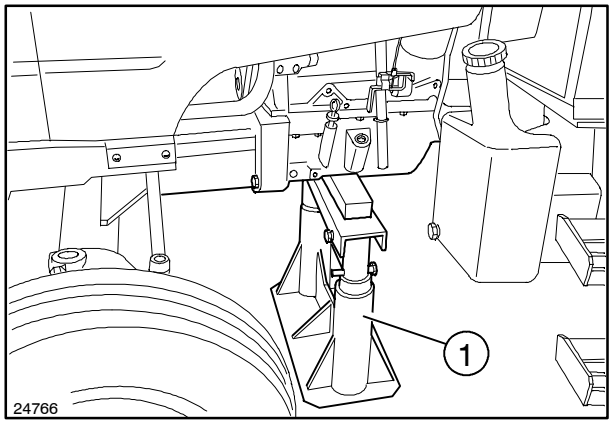
1. Lock the rear wheels using suitable chocks.

2. Lift the front of the tractor.



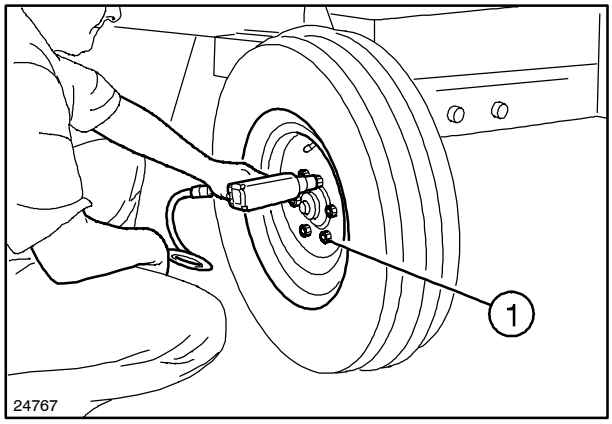
14

3. Place a mechanical stand (1) under the engine sump and insert a wooden block between the engine sump and the stand.



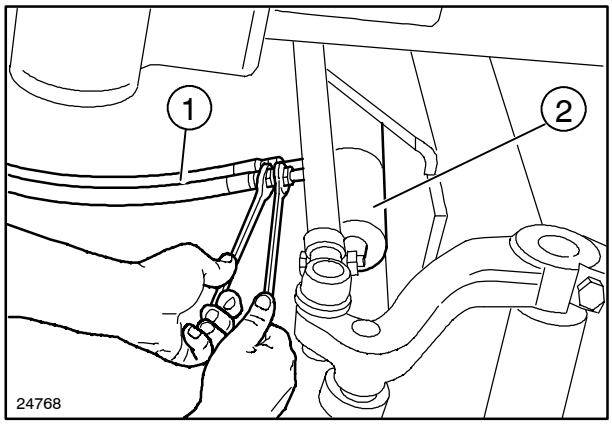
15

4. Remove the front wheel retaining bolts (1).



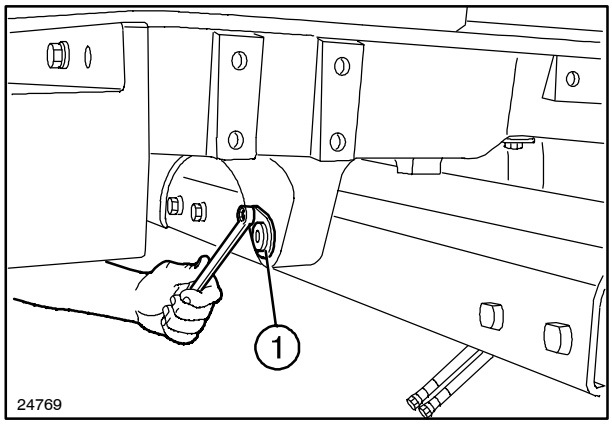
16

5. Disconnect the pipes (1) of the power steering cylinder (2).



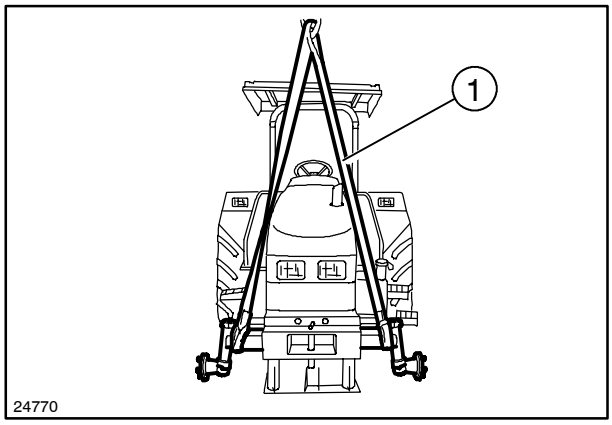
17

6. Remove the axle articulation pin retaining bolt (1).



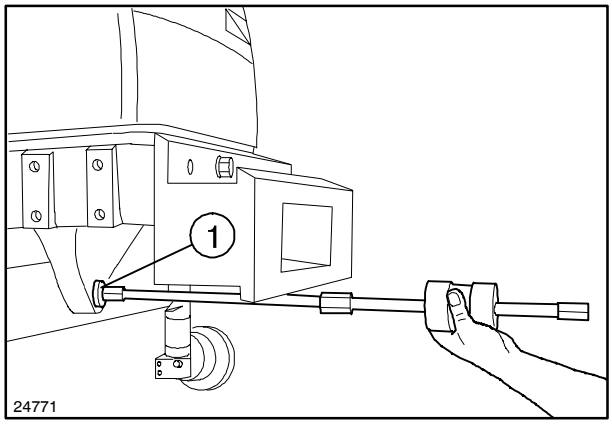
18

7. Secure the axle by means of a sling (1).



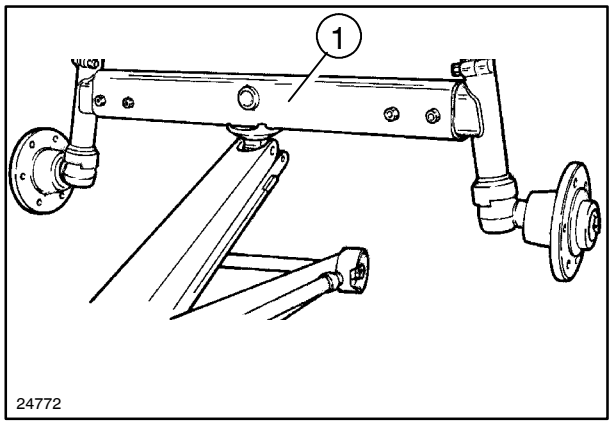
19

8. Extract the axle articulation pin (1) using an extractor tool fitted with adapter and extension.



20

9. Remove the axle assembly (1).



21

10. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refit the axle assembly on the tractor with the sling and, using a bronze striker, fit the axle articulation pin.

- Fit the axle articulation pin retaining bolt (1).

- Connect the hoses of the power steering cylinder.

- Fit on the front wheels and their retaining bolts.

- Remove the mechanical stand installed beforehand under the engine sump.

- Remove the chocks on the rear wheels.

Op. 44 101 46
STUB AXLE
Overhaul

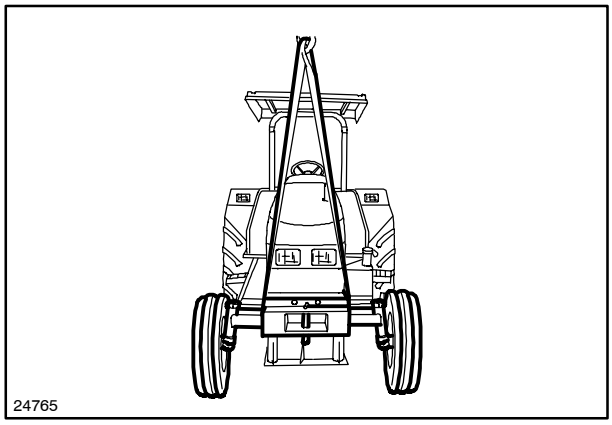
CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing – safety goggles, gloves and shoes.

The stub axles can be removed without removing the axle from the tractor, proceeding as follows for each individual wheel:

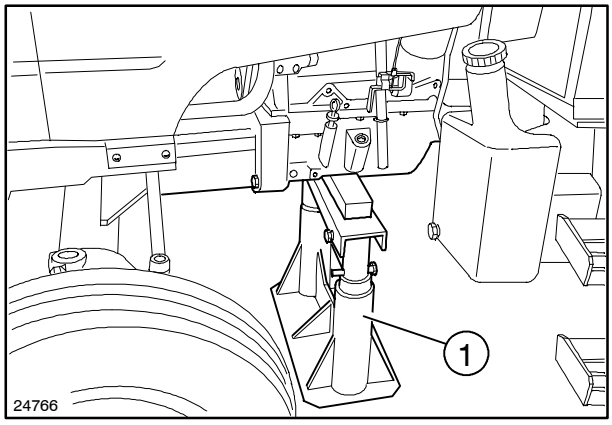
1. Lock the rear wheels using suitable chocks.

2. Lift the front of the tractor.



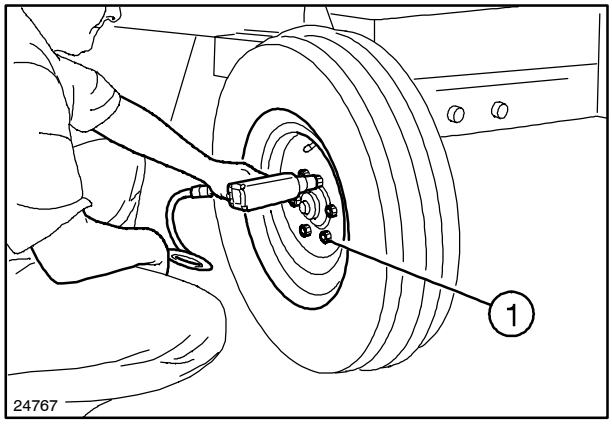
22

3. Place a mechanical stand (1) under the engine sump and insert a wooden block between the engine sump and the stand.



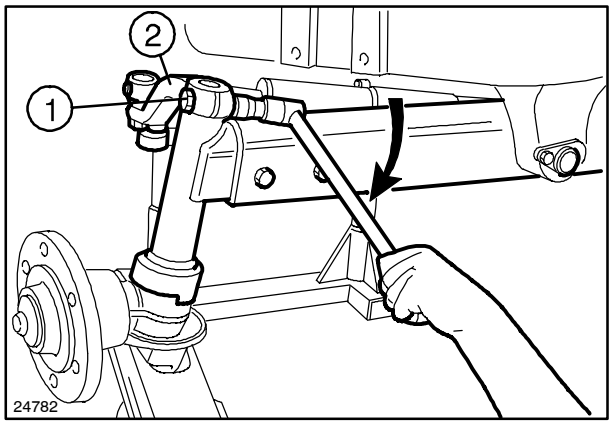
23

4. Remove the front wheel retaining bolts (1).



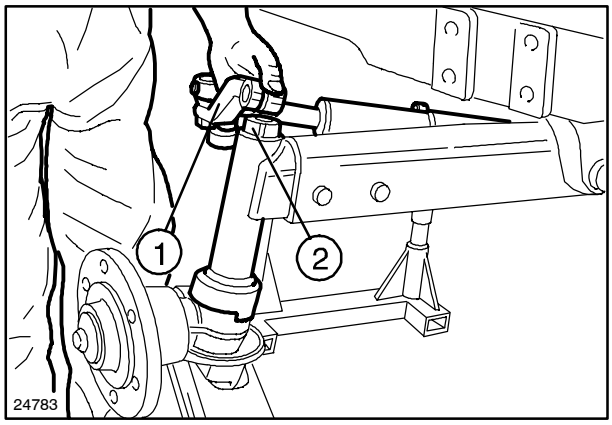
24

5. Position a hydraulic jack under the stub axle and unscrew the bolt (1) securing the control lever (2) to the stub axle pin.



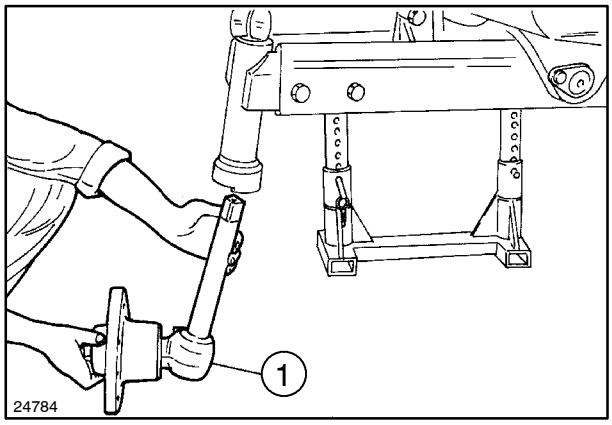
25

6. Extract the control lever (1) from the stub axle pin (2).



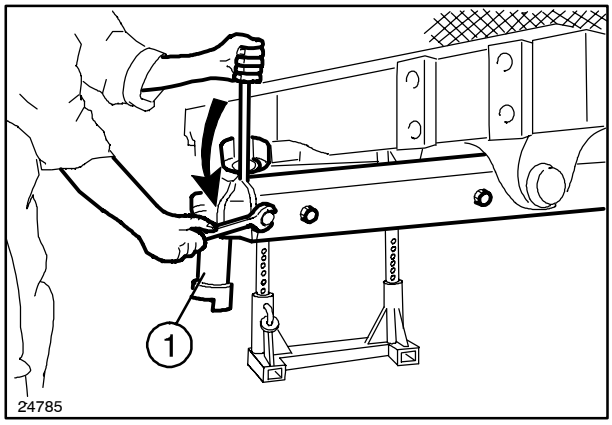
26

7. Lower the hydraulic jack and remove the stub axle (1).



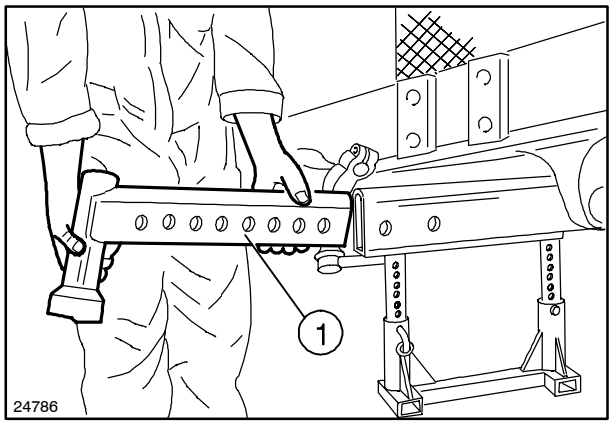
27

8. Take out the bolts securing the end of the axle (1).



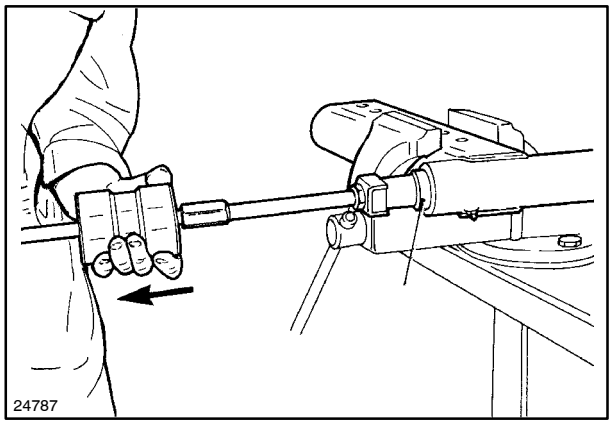
28

9. Remove the axle end (1).



29

10. Clamp the end of the axle in a vice and, using an extractor tool, extract the stub axle pin articulation bushings (1).

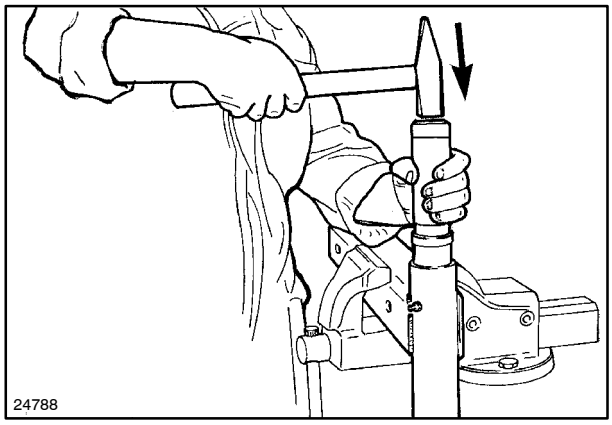


30

11. To assemble, proceed as follows:

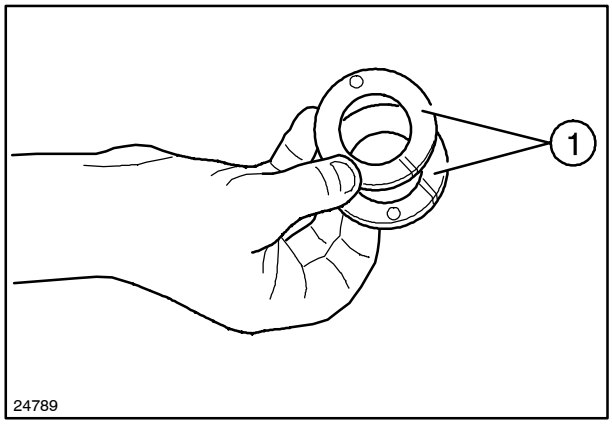
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.



31

- Refit the stub axle, using a striker to fit the new bushings on the axle ends.
- Fit the axle end.
- Unscrew the bolts securing the axle end.
- Refit the cup (9, fig. 2) at the base of the stub axle, then the bronze thrust rings (1) inserting them on the stop grub screws (8 and 14, as shown in fig. 2).
- Fit the stub axle on the axle end, using the hydraulic jack.
- Insert the control lever on the stub axle pin and tighten the retaining bolt.
- Fit on the front wheels and their retaining bolts.
- Remove the mechanical stand inserted beforehand under the engine sump.
- Remove the chocks on the rear wheels.



32

Op. 44 511 80
CHECKING 2 WD FRONT WHEEL CAMBER AND TOE-IN

Check the alignment of the leading wheels, bearing in mind that for driving in a straight line, the wheels must be at an angle of 2° to the ground, corresponding to a difference of approximately 0.5905 in. (15 mm), for 16" rims, between the top and bottom edges of the rim (fig. **a**).

When driving in a straight line, the wheels must also be parallel to longitudinal axis of the tractor, or have a maximum of 0.1968 in. (5 mm) toe-in at the front, as measured between the edges of the rims.

To check the toe-in exactly, proceed as follows:

1. Inflate the front tyres to a pressure of 36.26 psi (2.5 bar).

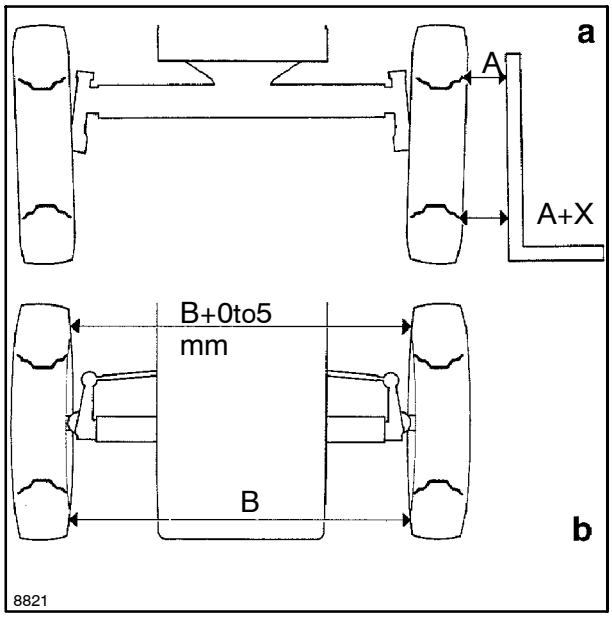
2. Position the steering wheel at the middle of its travel, with one spoke along the longitudinal axis of the tractor.

3. Check that the wheels are parallel to the longitudinal axis of the tractor.

4. On the horizontal plane passing between the centres of the wheels, measure the distance (B) between the **front inside edges** of the rims (see fig. **b**).

5. On the horizontal plane passing between the centres of the wheels, measure the distance between the **rear inside edges** of the rims, checking that the distance is equal to (B) or exceeds it by up to a maximum of 0.1968 in. (5 mm).

6. If necessary, correct the toe-in by adjusting the end of the transverse steering tie-rod.



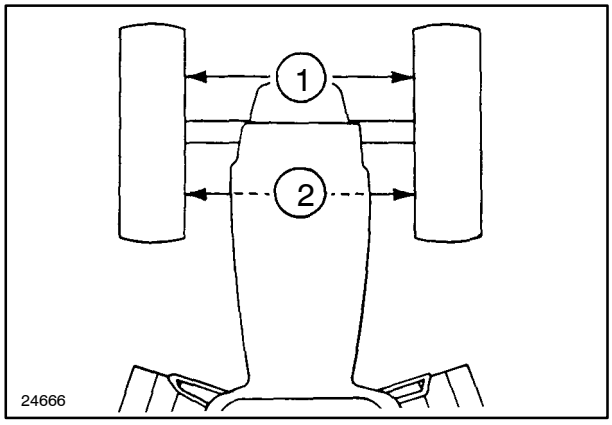
33

Op. 44 511 80
CHECKING 4 WD FRONT WHEEL ALIGNMENT

When travelling in a straight line, the wheels on four-wheel drive models must be parallel to the longitudinal axis of the tractor. A slight toe-in of the front wheels is permissible - up to a maximum of 0.2362 in. (6 mm), as measured at the edges of the wheel rims.

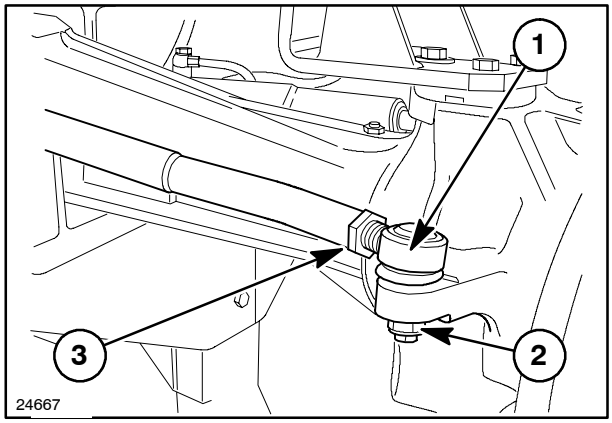
To check the exact value of the toe-in setting of four-wheel drive tractors, proceed as follows:

1. Inflate the front tyres to the prescribed pressure.
2. Position the steering wheel at the middle of its travel, with one spoke along the longitudinal axis of the tractor.
3. Check that the wheels are parallel to the longitudinal axis of the tractor.
4. Measure the distance (1) between the **front inside edges** of the rims.
5. Turn both front wheels through 180° then, at the height of the wheel hub centres, measure the distance (2) between the **rear inside edges** of the wheel rims, checking that the new measurement is equal to or greater than distance (1) by a maximum of 0.2362 in. (6 mm). The rotation of the wheels through 180° is required in order to eliminate the effect on the measurement of any wear on the rims.



34

6. If wheel toe-in needs to be adjusted, remove nut (2) and extract the track rod end (1) from its housing.
7. Loosen lock nut (3) and screw the track rod end (1) in or out to decrease or increase the distance (2, fig. 34).
8. Reposition the track rod end (1) in the housing and check the toe-in as described in points 4 and 5.
9. After having adjusted the toe-in to within the prescribed limits, tighten lock nut (3) to a torque value of 180 Nm (18.3 kgm) and nut (2) to 100 Nm (10.2 kgm).



35

NOTE: *The locknut (2) must be changed after disassembly every time.*

SECTION 50 - AUXILIARY UNITS

Chapter 1 - Auxiliary units

CONTENTS

Operation	Description	Page
	Safety regulations	2
	General specifications	3
	Tools	4
	Operating principles	5
	Main components of the cab air conditioning system	7
	Warnings for air conditioning system repair operations	11
	Cab controls	12
	Instructions for use - air conditioning system	15
	Refrigerant recovery - recycling and evacuation - charging stations	15
	Electronic leak detector 380000314	16
	Air conditioning system maintenance	17
	Air conditioning system troubleshooting	18
	Air conditioning system troubleshooting	19
50 200 03	Cab air conditioning system functional testing	23
50 200 06	Checking for gas leaks with leak detector 380000314	24
50 200 10	Compressor drive belts. Tension adjustment	25
50 200 26	Air conditioner compressor. R.I.	26
50 200 40	Heating pipes. Replacement	28
50 200 60	Air conditioning pipes. Replacement	30
50 200 72	Air conditioner condenser. Replacement	36
50 200 74	Dryer filter. Replacement	37
50 206 50	Cab heater unit. R.I.	39
50 206 56	Air conditioner evaporator. Replacement	42
50 206 66	Electric cab fan. R.I.	45

CAB AIR CONDITIONING SYSTEM

⚠ SAFETY REGULATIONS ⚠

The refrigerant must be handled with great care in order to avoid personal injury; always use safety goggles and gloves.

Liquid refrigerant can cause freezing of the skin and serious damage to the eyes, sometimes resulting in permanent blindness.

Keep the refrigerant container away from heat sources. Heat will cause an increase in pressure of the refrigerant and could cause the container to explode.

If refrigerant comes into contact with a naked flame or a hot metal surface it produces a toxic gas, which is dangerous if inhaled.

In order to avoid accidents follow the simple precautions described below.

The operation of emptying and charging the system must be carried out in a well-ventilated area, well away from any naked flames.

During the charging and emptying operations, take the necessary precautions to protect the face and above all the eyes from accidental contact with refrigerant.

In the event of an accident, proceed as follows:

- if the refrigerant makes contact with the eyes, wash immediately with a few drops of mineral oil, then continue washing with a solution of boric acid and water (one spoonful of acid in 1/4 glass of water). Request medical assistance immediately.
- freezing of the skin caused by contact with liquid refrigerant may be treated by gradually warming the injured area with cold water, followed by the application of a greasy cream.
  Request medical assistance.
- the air conditioning system contains a mixture of refrigerant and oil under high pressure; under no circumstances loosen pipe fittings/unions or work on the pipes without having first drained the system.
- do not loosen or remove the compressor oil level check cap with the system pressurised.
- do not heat the refrigerant container.
  If the temperature exceeds 122 °F (50 °C) the pressure increase rapidly.
- keep the air conditioning system away from heat sources to prevent explosions as a result of an increase in pressure in the system.

When transferring refrigerant from one container to another, only use homologated liquid refrigerant containers equipped with safety valves.

Never fill liquid refrigerant containers over 80% of their maximum capacity.

Do not modify the settings of safety valves and the control devices.

Never connect the recovery/recycling and evacuation/charging stations to electrical power outlets with voltages other than those specified; do not leave the stations powered up unless they are to be used immediately.

CAB AIR CONDITIONING SYSTEM CHARACTERISTICS

SANDEN SD 7H15 Compressor	
Number of cylinders	7
Total displacement cm^3	155
Maximum rotation speed rpm	6000
Weight kg	6.5
Quantity of lubricating oil cm^3	185
Type of lubricating oil (code)	PAG SP20

Air conditioning system	Gas HFC134a
Quantity of HFC-134a refrigerant lbs. (gr)	3.5273 (1600)
System delivery side pressure psi (bar)	232.07 to 348.10 (16 to 24)
System suction side pressure psi (bar)	7.25 to 43.51 (0.5 to 3)
Pressure switch setting (high pressure) psi (bar)	362.61 (25)
Pressure switch setting (low pressure) psi (bar)	29 (2)
Temperature of refrigerant fluid at compressor outlet °F (°C)	140 to 248 (60 to 120)
Temperature of refrigerant fluid at condenser outlet °F (°C)	104 to 140 (40 to 60)
Temperature of refrigerant fluid at evaporator outlet °F (°C)	0 to 59 (0 to 15)
Maximum capacity of electric centrifugal fan I. II, III speed m^3/min	3.5 to 8.5

VARIATIONS IN WORKING TEMPERATURES
OF THE CAB AIR CONDITIONING SYSTEM

External ambient temperature	68 °F (20 °C)	80.6 °F (27 °C)	82.4 °F (28 °C)	95 °F (35 °C)	96.8 °F (36 °C)	109.4 °F (43 °C)
Temperature of air at vent outlets (inside cab)	39.2 to 46.4 °F (4 to 8 °C)		42.8 to 53.6 °F (6 to 12 °C)		53.6 to 68 °C (12 to 20 °C)	

It should be remembered that altitude affects pressure, as indicated in the table.

In order to obtain the pressure value in the various sections of the system, the relative correction value must be subtracted from the pressure gauge reading.

Altitude feet (m) above sea level.	Absolute atmospheric pressure (kg/cm^2)	Correction (kg/cm^2)
0	1.029	0
984.25 (300)	0.994	- 0.035
1968.50 (600)	0.959	- 0.070
2952.75 (900)	0.924	- 0.105
3937 (1200)	0.889	- 0.140
4921.25 (1500)	0.854	- 0.175
5905.51 (1800)	0.819	- 0.210
6889.76 (2100)	0.791	- 0.238
7874.01 (2400)	0.763	- 0.268

TOOLS REQUIRED FOR SERVICING THE CAB AIR CONDITIONING SYSTEM

WARNING

The operations described in this section can only be carried out with the ESSENTIAL tools indicated by an (**X**).

To work in safety and to obtain the best possible results whilst saving both time and energy, we recommend that the other specific tools in the list are also used.

List of specific tools required for the various operations described in this Section	
X 380000315	Recovery, recycling, evacuation and charging station
380000314	Acoustic gas leak detector
X 380000312	Combs for cleaning and straightening the fins on the condenser and evaporator

OPERATING PRINCIPLES

The function of the air conditioning system is to create and maintain optimum working conditions inside the tractor cab.

The climate inside the cab essentially depends on four factors:

- temperature;
- humidity;
- speed;
- purity of the air in the cab.

Obviously “ideal” conditions will vary from person to person, and so it is not possible to specify optimum values for the above factors; however, we can specify a range of values within which the majority of people will feel most comfortable.

As regards temperature and humidity, we can define a zone, known as the ’comfort zone’, within which the temperature and humidity combination corresponds to satisfactory climatic conditions.

From the diagram it can be seen that humidity should be within the range of 30% to 70%. Below 30% there is excessive dehydration of the mucous tissue of the nose and throat, whereas above 70% an uncomfortable sense of dampness may be perceived. The temperature may therefore vary between 64.4 and 82.4 °F (18 and 28 °C).

The air flow speed must not be so high as to cause discomfort; speeds of 0.07 - 0.25 m/s are normally acceptable.

Simplified psychometric diagram

1. Sensation of unbearable coldness.
2. Sensation of coldness.
3. Comfort zone.
4. Sensation of heat.
5. Sensation of unbearable heat.

As regards air purity, no precise limits have been defined; however, it is important to remember that the human organism gradually alters the composition of the air in the surrounding environment by breathing, increasing the amount of carbon dioxide and humidity, and decreasing the amount of oxygen, etc.

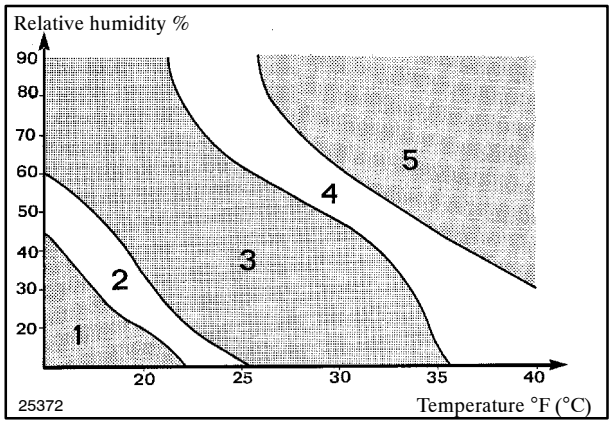
These problems can be eliminated by allowing a small flow of external air to enter the cab. However, as agricultural tractors are often used in dusty conditions (dust from the earth, hay, etc.), the installation of dry filters on the external air inlets provides a simple solution.

The use of air conditioning in tractors and agricultural machinery in general serves to neutralise unpleasant climatic conditions inside the cab; the air conditioning system controls the temperature and humidity of the air drawn into and already present in the cab so as to maintain a comfortable climate for the operator.

The operating principle of the system is similar to that of a domestic refrigerator: heat is removed from the air by means of a physical process (the evaporation of a liquid) which draws heat from the surrounding environment.

The liquid used in this process (refrigerant) is a product with a high refrigeration coefficient, low toxicity and mixes well with lubricating oils.

The various components of the system are connected by pipes in which the refrigerant circulates.



1

The air conditioning system comprises five main components:

1. compressor;
2. condenser;
3. filter/dryer;
4. expansion valve;
5. evaporator.

To understand the operating cycle of the system, follow the flow of the refrigerant starting from the compressor (1).

The compressor draws in vaporised refrigerant at a pressure of 0.5 to 3 compressing it to a pressure of 232.07 to 348.10 psi (16 to 24 bar).

The refrigerant, heated by compression to 140 to 248 °F (60 to 120 °C), is directed to the condenser coil (2) (still in vapour form) located in front of the engine radiator.

The air flow, produced by the electric fan and the forward movement of the tractor, cools the refrigerant by means of heat exchange.

This action cools the refrigerant to the point of condensation between 104 to 140 °F (40 to 60 °C) depending on the outside temperature, changing the vapour into liquid.

The refrigerant, in liquid state at high pressure, is purified by passing through the filter/dryer (3) from where it flows to the expansion valve (4), which restricts the flow of refrigerant and thus reduces its pressure.

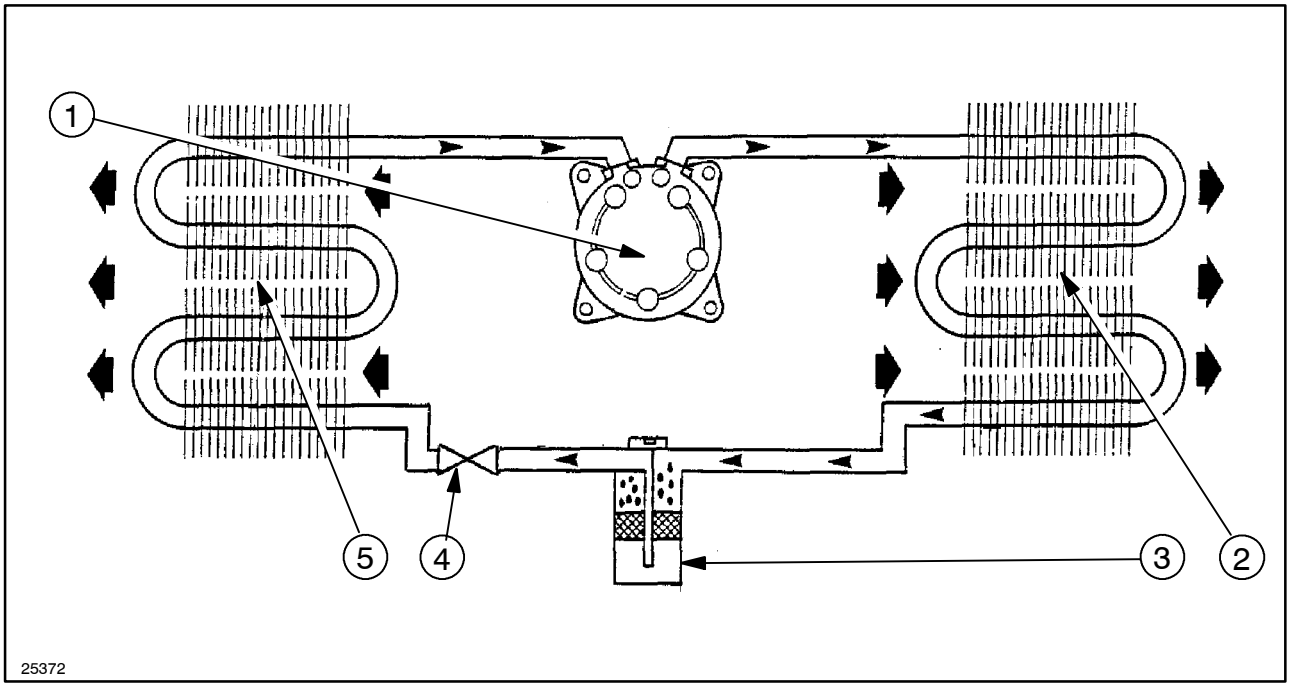
As it passes through the expansion valve (4), part of the refrigerant is transformed into vapour and the low temperature mixture of vapour and liquid thus formed enters the evaporator (5).

Here the electric fan causes a continuous circulation of the cab air over the fins of the evaporator (5), helping the refrigerant to absorb heat from the air and thus change completely from a liquid to vapour.

The evaporation process removes heat from the air passing over the evaporator (5) and thus reduces the temperature inside the cab.

The flow of air over the cold surface of the evaporator (5) also condenses some of the moisture in the air and therefore reduces the humidity in the cab.

On leaving the evaporator (5) at 0 to 59 °C (0 to 15 °C) the low pressure mixture is taken in by the compressor (1) to start a new cycle.



2

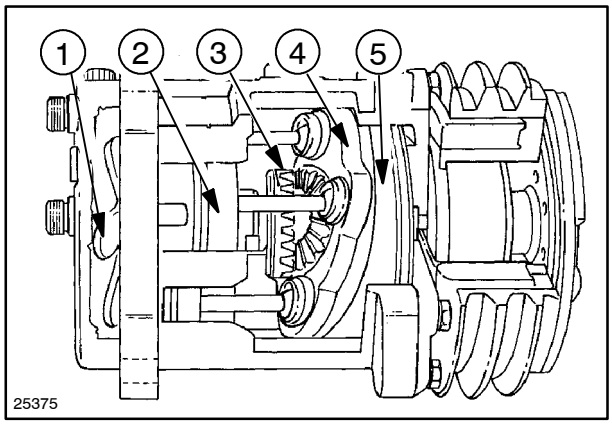
Schematic diagram of the air conditioning system

1. Compressor.
2. Condenser.
3. Filter/dryer.
4. Expansion valve with thermostatic sensor.
5. Evaporator.

MAIN COMPONENTS OF THE AIR CONDITIONING SYSTEM

Axial flow reciprocating piston compressor SANDEN SD 7H15

1. Combined inlet and discharge valve.
2. Piston with seal ring.
3. Drive gear.
4. Connecting rod disk.
5. Cam rotor.



3

Compressor

The compressor serves to pressurise the refrigerant and force it through the system.

SANDEN SD 7H15 MODEL

Axial reciprocating piston type, driven by the engine crankshaft via a vee belt.

The operation of the compressor can be summarised as follows:

The swashplate (4), on which pivot the ball ends of the connecting rods of the pistons (2), rests on the cam rotor (5).

Driven by the compressor pulley, as the cam rotor (5) rotates it exerts a continuous thrust on the swashplate (4), which is prevented from rotating by the coupling with the fixed gear (3).

The angle of the rotor cam (5), in relation to the axis of rotation, causes the reciprocating movement of the pistons (2).

The piston head (2) is fitted with a reed valve (1) with seven lobes (one for each piston), and controls the inlet and discharge stages of the cylinders (2).

The valve opening and closing system is automatic, achieved by preloading of the shutter blades.

The rotating parts of the compressor are lubricated by special oil, inserted during assembly, some of which circulates through the system mixed with the refrigerant.

Condenser

The condenser is the system component in which the refrigerant vapour condenses to form a liquid.

The condenser works in similar way to the engine cooling radiator, allowing the vapour to give up heat to the external air.

It comprises a series of inner tubes through the refrigerant flows and an outer shell consisting of a series of thin aluminium fins which increase the surface area in contact with the cooling air flowing through the condenser.

The condenser is fitted opposite the engine radiator, in the best position for the air flow necessary for heat exchange.

Filter/dryer

The filter/dryer, fitted near the compressor and positioned between the condenser and the expansion valve, performs two basic functions:

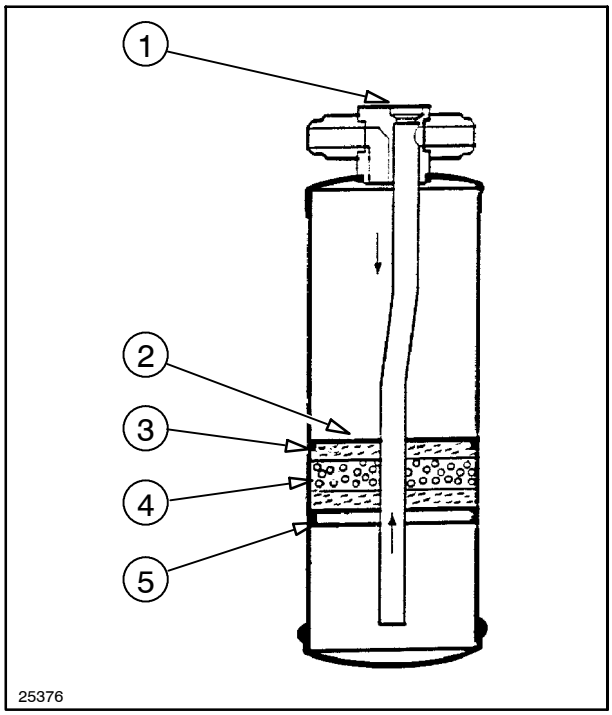
acting as a filter to remove solid and liquid particles from the refrigerant,

and as a temporary storage container during variable charge stages.

It is important to eliminate water from the system to prevent corrosion and consequent damage to the components.

The filter therefore contains substances capable of absorbing humidity.

Solid particles, such as grit, oxides, metal particles produced by the mechanical wear of the compressor, etc., can also damage the system and so the filter incorporates screens to retain them.



4

Filter/dryer

1. Sight glass.
2. Upper screen.
3. Disk.
4. Drying unit.
5. Lower screen.

Thermostatic expansion valve

This valve serves to reduce the pressure of the liquid refrigerant from the condenser so that the refrigerant entering the evaporator can evaporate and thus take heat from the air which is to be cooled.

The expansion valve has two main functions:

- dosage: the calibrated bore (6, fig. 5) inside the valve body creates a difference in the pressure of the refrigerant between the inlet (4) (liquid state) and the outlet (7) (mixed liquid/vapour state); the calibrated bore (6) also serves to atomise the refrigerant to facilitate subsequent evaporation;
- modulation: inside the valve body a thermostatic sensor controls the valve aperture so that the right quantity of refrigerant enters the evaporator to ensure complete evaporation.

If the thermostatic sensor (2, fig. 5) detects an increase in the temperature of the refrigerant at the evaporator outlet, the flow of refrigerant is increased.

If the temperature in the cab drops or the compressor starts to operate at a higher capacity (due to an increase in engine speed), the flow rate into the evaporator is reduced.

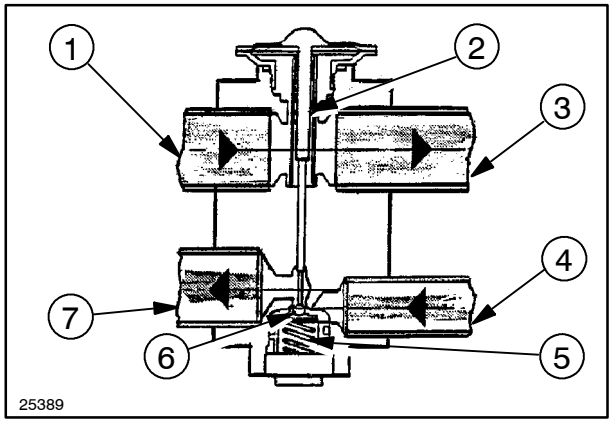
The expansion valve is installed on the evaporator inlet fitting (7), and as the internal refrigerant flow control system is completely automatic, it requires no special maintenance.

To perform functional testing, with the system is fully charged, check that the system operating pressures are those indicated on page 3.

NOTE: *In the event of malfunction, replace the valve.*

Expansion valve block.

1. From the evaporator outlet.
2. Thermostatic sensor.
3. To compressor suction inlet.
4. From filter/dryer.
5. Spring.
6. Calibrated bore and ball.
7. To evaporator inlet.



5

Thermostatic switch (ANTIFROST)

The thermostat is a safety device, fitted with a sensor (1) inserted on the evaporator fins (2), where it constantly monitors the temperature.

The sensor head (1), contains a gas which is sensitive to evaporator temperature variations, varying the volume inside the sensor.

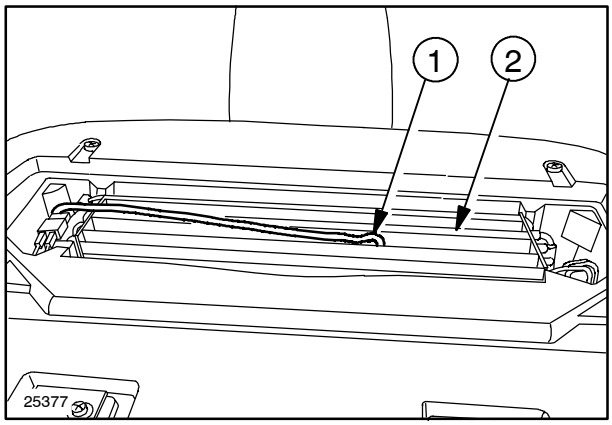
The variation of the volume inside the sensor head (1), acting on a membrane connected to a mechanism, opens or closes the electric circuit connected to the compressor electro-magnetic clutch.

The opening or closing of the compressor electro-magnetic clutch electric circuit causes the compressor to engage or disengage.

The thermostatic sensor (1) therefore prevents ice from forming on the evaporator, as a result of the treatment of extremely damp air, and obstructing the flow of air into the cab.

For this reason it is important that the thermostatic sensor (1) is always inserted between the evaporator fins (2, fig. 6), in order that the system can function correctly.

NOTE: *In the event of faulty operation, replace the thermostatic switch.*



6

Evaporator

The refrigerating cycle is completed in the evaporator.

The refrigerant at the expansion valve outlet is a mixture of vapour liquid at low temperature and low pressure.

As it passes through the evaporator radiator the refrigerant absorbs heat from the cab air, evaporates, and is then taken in by the compressor as vapour.

The operation of the evaporator is controlled by the expansion valve which regulates the flow of refrigerant to obtain the required degree of air cooling.

The evaporator performs the opposite function to the condenser, but it is constructed in a similar way; the only differences being the overall dimensions and the internal pipe layout.

The evaporator also dehumidifies the air.

The air passing over the evaporator contains a certain quantity of moisture, and this must be kept within certain limits for operator comfort.

Some of the humidity in the air condenses on the fins of the evaporator.

The centrifugal fan draws the ambient air through the fins of the evaporator (where it is cooled and dehumidified) and into the cab.

The housing around the evaporator is equipped with a condensate trap from which the condensate is carried outside the vehicle through discharge tubes.

WARNINGS FOR AIR CONDITIONING SYSTEM REPAIR OPERATIONS

Starting the system at low temperatures can damage the compressor. Only operate the air conditioner when the engine is hot and the temperature inside the cab is at least 68 °F (20 °C).

When disconnecting the hoses, close the ends with plastic caps to prevent foreign matter and humidity from getting inside the hoses.

Handle the thermostatic sensor carefully during removal, to avoid damage that may prevent efficient system operation.

Always use two spanners to unscrew the hose fittings to avoid twisting the fitting.

Do not use any type of engine oil to lubricate the compressor and the system.

Never leave the compressor oil container open, always make sure that it is tightly closed. If left exposed the oil will absorb humidity from the air and may, subsequently, damage the system.

Do not transfer compressor oil from the original container to another container.

Do not introduce any additives to the compressor oil. Any additional substances could contain elements which are incompatible with the chemical base of the refrigerant and thus alter its characteristics.

Check that the thermostatic sensor is correctly inserted in the fins on the evaporator to ensure efficient system operation.

CAB HEATING AND VENTILATION CONTROLS

Ventilation

Turn on the cab ventilation by means of the switch (1, fig. 7) and direct the air flow by positioning the front vents (2).

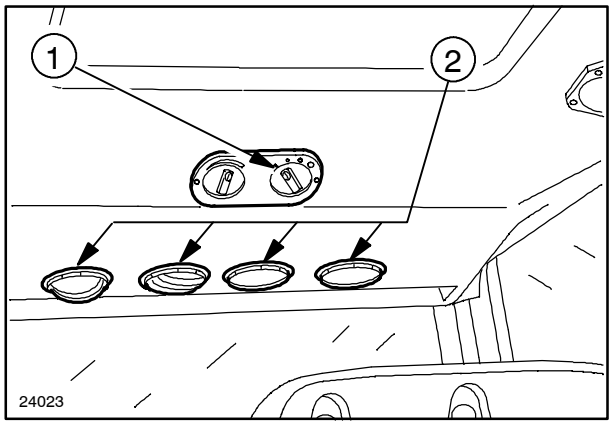
Air may be selected from inside or outside the cab by adjusting the rear recirculation vents (1, fig. 8) which can be placed in two positions.

- vents closed: air comes from outside via the side filters.
- vents open: a larger quantity of air comes from inside, via the vents.

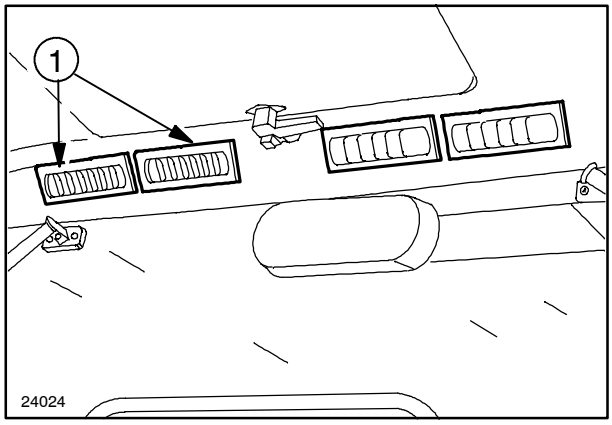
Fresh air drawn into the cab from outside is always filtered.

When the electric fan is operating and with the doors, re-circulation vents and windows closed, the pressure inside the cab is higher than the pressure outside, and consequently air can only enter the cab via the side filters.

NOTE: To increase cab pressure, *air must only be taken from the outside (air re-circulation vents 1, fig. 8 closed).*



7



8

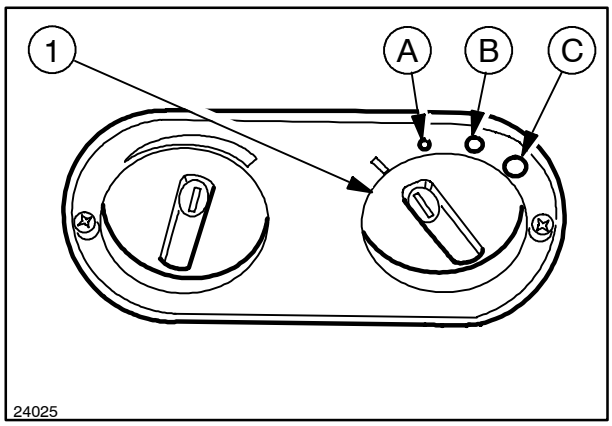
Electric fan

The fan control switch (1, fig. 7 and 9) is powered up when the ignition switch (1, fig. 11) is in position **B**.

A. Low speed.

B. Medium speed.

C. High speed.



9

Air Filter

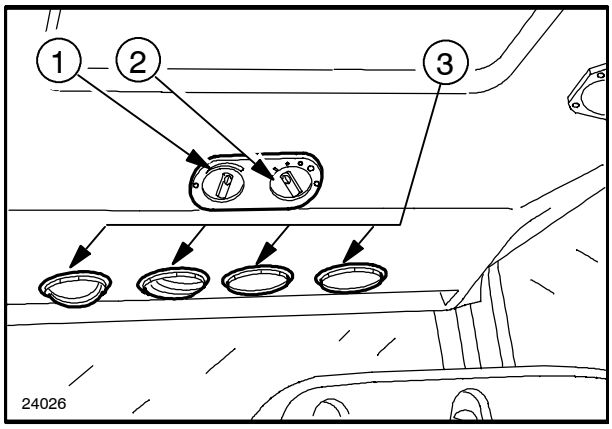
DANGER

Remember that the filters of the cab provide no protection against anti-parasitic chemicals in general. Therefore complete protection against these products can only be achieved by the adoption of additional specific safety measures for the single product. This applies to all types of filter, for which the prescriptions for use and maintenance must be followed scrupulously. Even the use of active carbon filters does not exempt the operator from adopting the personal safety precautions recommended for the product in question.

HEATING

The heating control knob (1, fig. 10) allows the operator to regulate the air temperature, by increasing or decreasing the coolant circulation from the engine.

The electric fan control switch (2) allows the operator to regulate the quantity of air entering the cab through vents (3, fig. 10) and (1, fig. 8).



10

Temperature control knob (1)

- Turned fully to the left in an anticlockwise direction = minimum temperature (hot water circulation off).

- Turned fully to the right in a clockwise direction = maximum temperature (hot water circulation fully open).

NOTE: *The total capacity of the cooling system (including the cab heating system) is 4.22 gallons (16 litres) for all the models in the TL series.*

IGNITION SWITCH

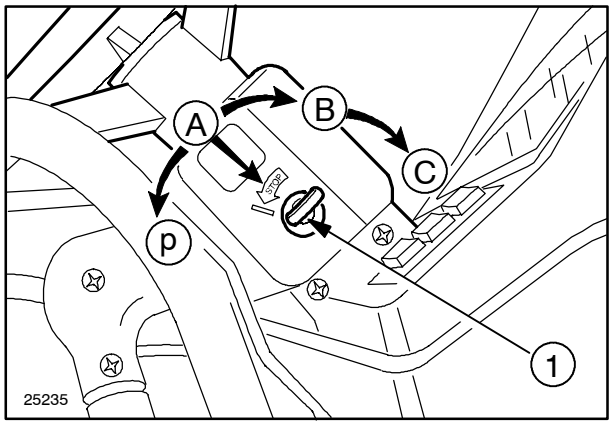
To operate the four switch functions, turn the key (1) through the following positions:

A. No power supply to any of the circuits (key can be removed). Engine stopped: automatic activation of fuel injection cut-off.

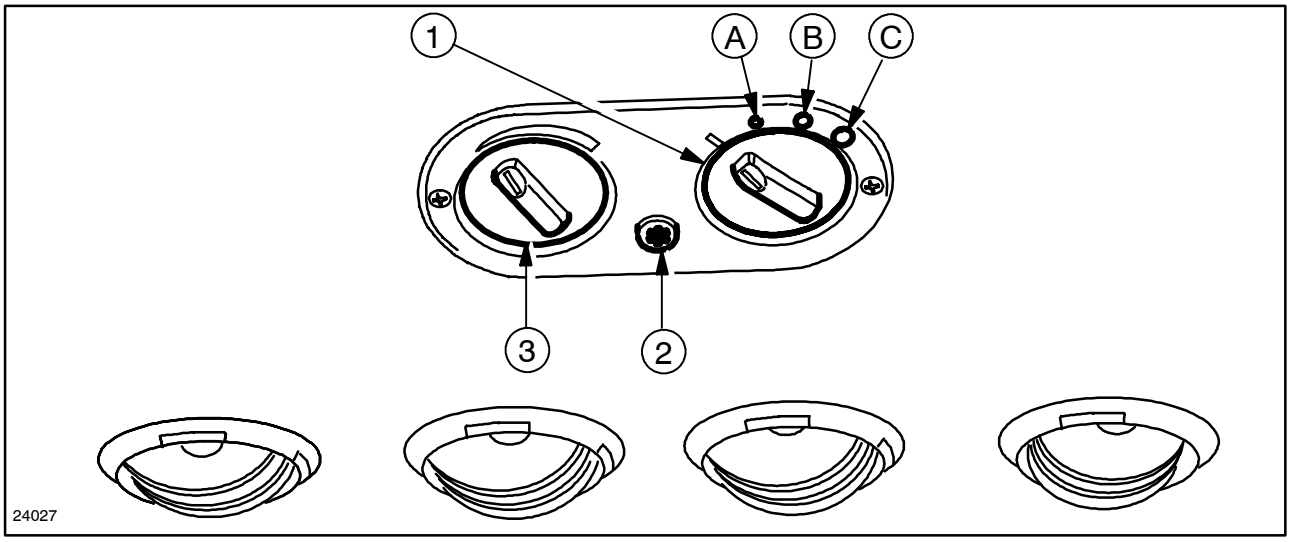
B. Standby for engine start up. Operation of panel lights and instruments, various circuits powered up.

C. Engine start up: if released, the key returns automatically to position (B).

p. Sidelights ON, control panel illuminated, auxiliary lights powered up (the key can be removed).



11



12

AIR CONDITIONED CAB CONTROLS

SWITCHING ON THE CONDITIONER AND TEMPERATURE ADJUSTMENT

Air conditioning and temperature control button

Functions when the ignition switch (1, fig. 11) is in the starting position (B).

With fan control knob (1) in positions A-B or C, press push-button (2) to switch on the air conditioning.

Heater control

For maximum temperature, turn the knob (3) clockwise (fully to the right).

To shut off the water supply to the heater and switch off the heater, turn the knob (3) fully anticlockwise.

3-speed electric fan control knob

This switch operates with the starter key (1, fig. 11). in position (B).

A. Low speed.

B. Medium speed.

C. High speed.

NOTE: *For cab pressurisation see the heading* ***Ventilation*** *on page 12 in this section.*

AIR CONDITIONING SYSTEM - INSTRUCTIONS FOR USE

The air conditioning system provides cool or warm dehumidified air.

NOTE: *When the engine is not running, the air conditioner will not work because the compressor is driven by the engine.*

To operate the system, proceed as follows:

START UP

WARNING

Before starting the engine, make sure that the air conditioning push-button (2, fig. 12) is in the OFF position.

Start the engine and proceed as follows.

WARNING

Before switching on the conditioner, always switch on the electric fan.
When the fan is switched off the air conditioning will not function.

ADJUSTMENT

For a correctly air conditioned cab, open the re-circulation vents when the air conditioning is running, and keep the doors, roof and rear window closed.

To lower the temperature in the cab and, at the same time, reduce the air humidity, turn the knob (3, fig. 12), anticlockwise until the desired temperature is obtained.

NOTE: *When working in very dusty environments, the cab pressure may have to be increased to prevent dust from entering the cab; you are also advised to close the re-circulation vents.*

If only the dehumidification function on the air conditioning system is required, without lowering the air temperature, turn the knob (3, fig. 12) clockwise until the desired temperature is obtained.

To restore the temperature in the cab after a prolonged halt in the sun, start the tractor, switch on the air conditioning and after about a minute open the rear fanlight or the roof to let the hot air escape.

STOPPING

Before stopping the engine, always turn off the conditioner by pressing button (2, fig. 12), to the stop position and moving the electric fan control knob (1) to the OFF position.

AIR-CONDITIONING SYSTEM RECOVERY-RECYCLING-EVACUATION-CHARGING STATION (380000315)

CAUTION

Do not use recovery/recycling and system emptying/charging machines which are designed for use with a refrigerant type other than that used in the system. Different types of refrigerant have different chemical compositions and are incompatible.

Description

The station is designed to initially recover and recycle the refrigerant used in air conditioning system.

Recovered refrigerant is first subjected to an evaporation process in a special chamber to remove any oil.

In the filter section, the acidity is neutralised, moisture is absorbed and solid particles are screened out.

The decontaminated refrigerant is then stored in the metering cylinder.

The station then drains and recharges the conditioning system with refrigerant.

The emptying stage is necessary to remove any moisture and impurities from the system.

As regards system recovery-recycling and evacuation-charging, refer to the Operator's manual provided with control unit 380000315.

LEAK DETECTOR (380000314)

The leak detector **380000314** is supplied in its own carrying case which also contains the two power supply batteries, the sensitivity test phial and an ear plug connection for audible leak indication.

The instrument comprises the main unit and the flexible probe which contain the sensor at the tip.

To correctly position the flexible probe, slacken off (anticlockwise) the thumbscrew located on the bottom left-hand corner of the case.

Mounted on the front of the instrument are the on/off switch, the red on/off LED and the acoustic gas detection indicator.

The socket for the headset connection is on the rear of the instrument. The battery compartment also houses the sensor element and a number of replacement felts.

Use

Set the switch to ON: start looking for leaks; the frequency and amplitude of the acoustic signal increases as the sensor approaches the source of a leak.

In the area around the leak, switch the instrument on and off again; the instrument will automatically switch to a new acoustic level. Carry out the following test each time you use the detector.

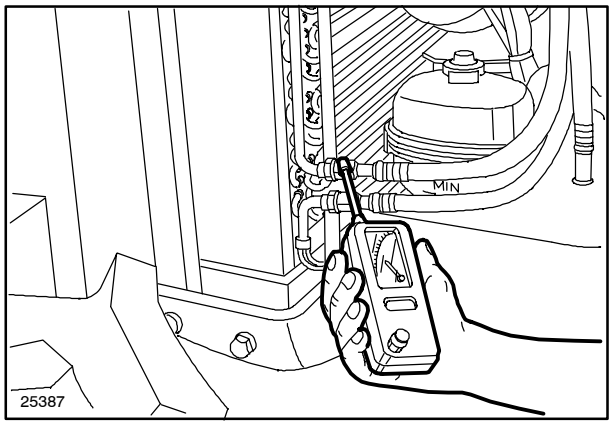
Hold the sensor element close to the open sensitivity test phial; when the detector starts to emit an audible signal, switch it on and off.

Refrigerant gas leak test

The detector automatically adjusts its sensitivity in accordance with the quantity of gas present in air around the sensor tip when switched on and off.

In ventilated airs it can be extremely difficult to locate the source of a gas leak, as the leaking gas does not remain near the leakage point; in this case, it will be necessary to screen off the area in which the leak is suspected to obtain more accurate readings.

In cases where the presence of large leaks masks smaller leaks, first locate and repair the large leaks before attempting to locate the smaller leaks; this will facilitate the location of the smaller leaks.



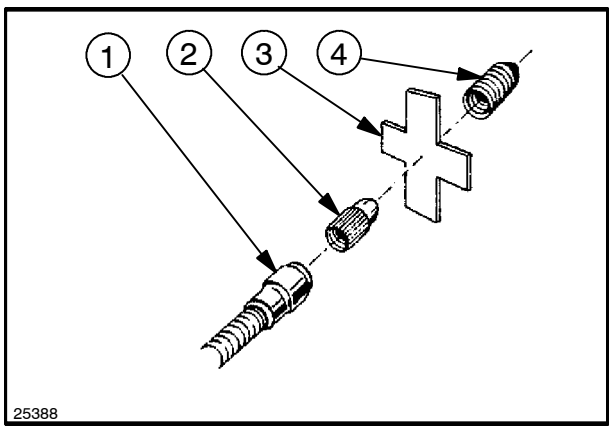
13

Maintenance

Always make sure that the detector is switched off before replacing the sensor element. To replace it, turn it anticlockwise, install a new sensitive element and a new felt, turning them clockwise on the flexible probe.

Do not switch on the detector until the new sensor is screwed firmly on to the end of the flexible probe.

Be careful to avoid getting grease or grit in the hole connecting the probe with the sensor element.



14

Leak detector probe

1. Flexible probe
2. Sensing tip
3. Felt pad
4. Protective shield

MAINTENANCE OF THE AIR CONDITIONING SYSTEM

At the start of the season in which it will be used, check the efficiency and operation of the system.

If the system has been out of use and charged for a prolonged period, oil may have flowed out of the compressor to other parts of the system and consequently this oil must be returned to the compressor.

For this purpose, start the engine and run at 1500 rpm for around 10 minutes.

Set the cab ventilation fan to maximum speed. Press the push button (2, fig. 12) to switch on the air conditioning.

Check that the relative temperatures of the external ambient air and the air flowing out of the vents inside the cab correspond to the values indicated in the table on page 23.

If the temperature values are correct, the system is perfectly efficient and only requires a visual inspection of the main components:

1) COMPRESSOR: check the mountings, the tension of the drive belt and the oil level.

2) CONDENSER: check the mounting and that the fins are free of excessive deposits. Straighten any bent fins using the comb tool **380000312**.

NOTE: *Carry out the same checks on the EVAPORATOR (9) and the CONDENSER (5).*

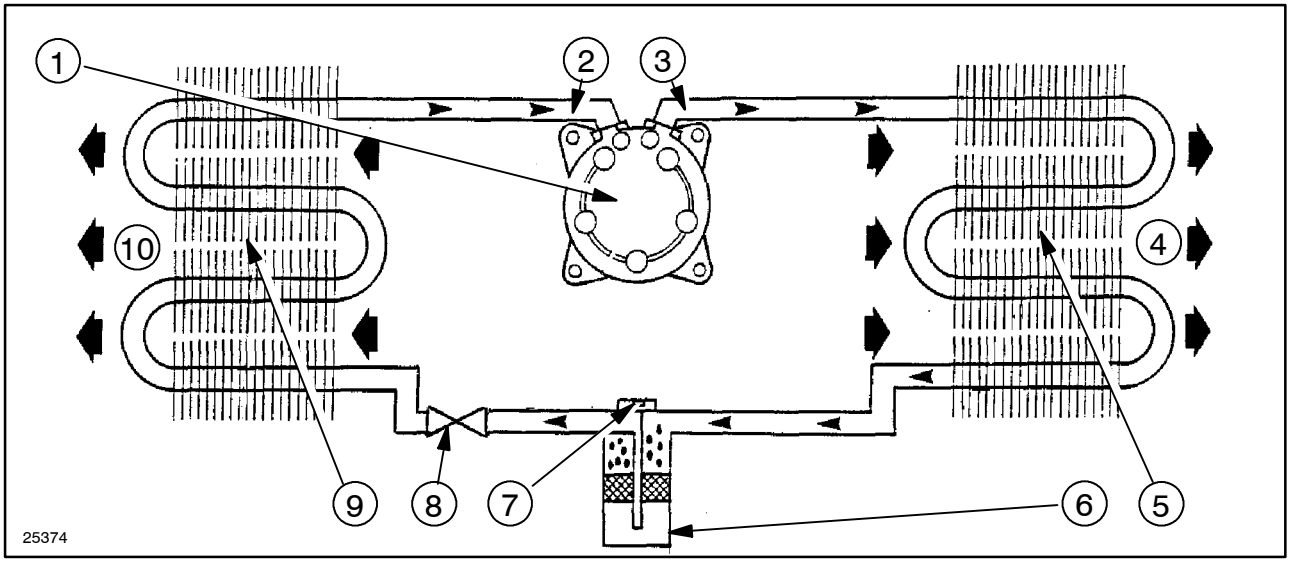
3) FILTER/DRYER: Replace the filter/dryer after the system has been repaired on two occasions.

4) EXPANSION VALVE: this valve does not require maintenance; in the event of malfunction, check the valve and thermostatic sensor as indicated on pages 9 and 10 or contact specialised personnel of the CNH service network.

If the temperature of the air at the vent outlets does not conform to the indications given in the table on page 23 proceed with the system troubleshooting operations described on page 18.

CAUTION

Caution - If any of the system components need to be replaced, follow the recovery, recycling and charging operations, using control unit 380000315.



15

Schematic diagram of the air conditioning system.

1. Compressor.
2. Inlet pipe (low pressure).
3. Outlet pipe (high pressure).
4. Warm air.
5. Condenser.
6. Filter/dryer.
7. Sight glass.
8. Expansion valve with thermostatic sensor.
9. Evaporator.
10. Cool, dehumidified air.

CAB AIR CONDITIONING SYSTEM TROUBLESHOOTING

There are three main ways in which the system can fail:

- the system does not work at all;
- the system does not provide sufficient cooling;
- the compressor operates irregularly.

Bearing in mind that insufficient cooling may also be due to external causes.

Generally a mechanical and visual inspection will provide information on how the system is operating.

Visual inspection of components

All visual inspection should be carried out with the engine stopped and the cab heating and air conditioning system switched off.

- Check that the compressor and support are correctly secured, and check the pulley alignment and tension of the compressor drive belt.
- Look for visible leaks of liquid refrigerant on hoses or system fittings.
- Look for visible leaks of liquid refrigerant.
- Visually check the condition of all fittings, unions and pipes, above all those in contact with the engine, as well as all retainer fittings and clamps.
- Check that the engine, condenser and evaporator radiators are clean.
- Check the condition and location of the thermostatic sensor (fig. 6) in the evaporator.
- Check that the cab external air intakes are clean (not clogged).
- Check the condition of the condensate drain lines.

This information can then be supplemented by electrical testing.

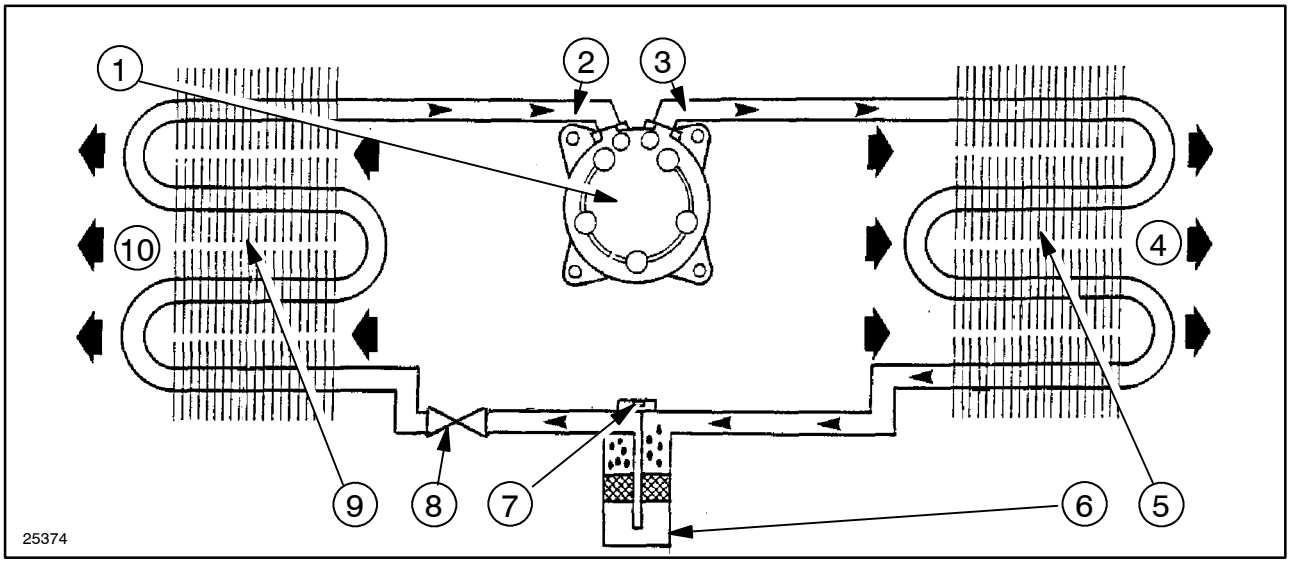
If the cause of the problem has still not been identified, it will be necessary to carry out a more thorough investigation, as indicated on page 23.

AIR CONDITIONING SYSTEM TROUBLESHOOTING *(CONT.)*

THE AIR CONDITIONING SYSTEM DOES NOT WORK

1. Check fuses.
2. Check compressor drive belt tension.
3. Check if the clutch coil is receiving power.
4. Check that the earth contact is efficient.

5. Check the system control devices - relays, wiring, thermostat, etc.
6. Visually check the condition of all fittings, unions and pipes.
7. Check the clearance between the front disk and the pulley of the electromagnetic clutch.



16

Schematic diagram of the air conditioning system.

1. Compressor.
2. Inlet pipe (low pressure).
3. Outlet pipe (high pressure).
4. Warm air.
5. Condenser.
6. Filter/dryer.
7. Sight glass.
8. Expansion valve with thermostatic sensor.
9. Evaporator.
10. Cool, dehumidified air.

AIR CONDITIONING SYSTEM TROUBLESHOOTING *(CONT.)*

INSUFFICIENT COOLING

HIGH DISCHARGE PRESSURE AND/OR HIGH SUCTION PRESSURE

EXCESS REFRIGERANT IN SYSTEM

Evacuate refrigerant until both pressure gauges indicate the normal pressure values shown on page 3.

CONDENSER

1. The condenser could be clogged or it might not be receiving an adequate air flow. Clean the fins on the condenser surface and check that the distance between the radiator and the condenser is correct.

EXPANSION VALVE

Check the valve, as indicated on page 9.

1. If the valve fails the test, replace it.

DISCHARGE PRESSURE LOW AND/OR SUCTION PRESSURE LOW

Insufficient refrigerant. Possibly due to small leaks.

1. Check system for leaks and eliminate if found.
2. Add refrigerant until both pressure gauges indicate the normal pressure values shown on page 3.

DISCHARGE PRESSURE NORMAL AND/OR SUCTION PRESSURE NORMAL

NOTE: *During testing, the low pressure gauge reading could fall to negative values or remain normal.*

HUMIDITY IN THE SYSTEM

1. Evacuate the refrigerant from the system.
2. Replace the filter-dryer.
3. Remove all air from the system then proceed with re-charging.

AIR CONDITIONING SYSTEM TROUBLESHOOTING *(CONT.)*

INSUFFICIENT COOLING

DISCHARGE PRESSURE NORMAL AND/OR SUCTION PRESSURE NORMAL

NOTE: *The high pressure gauge reading should be constant and should not fall.*

AIR IN THE SYSTEM

1. Recover-recycle the refrigerant in the system.
2. Replace the filter-dryer.
3. Evacuate the system and then re-charge.

DISCHARGE PRESSURE LOW AND/OR SUCTION PRESSURE LOW

RESTRICTION

Water or ice forms downstream of the restriction (on filter-dryer or on the pipe between the condenser outlet and the expansion valve).

1. Remove the relevant component and eliminate the restriction or replace the component.

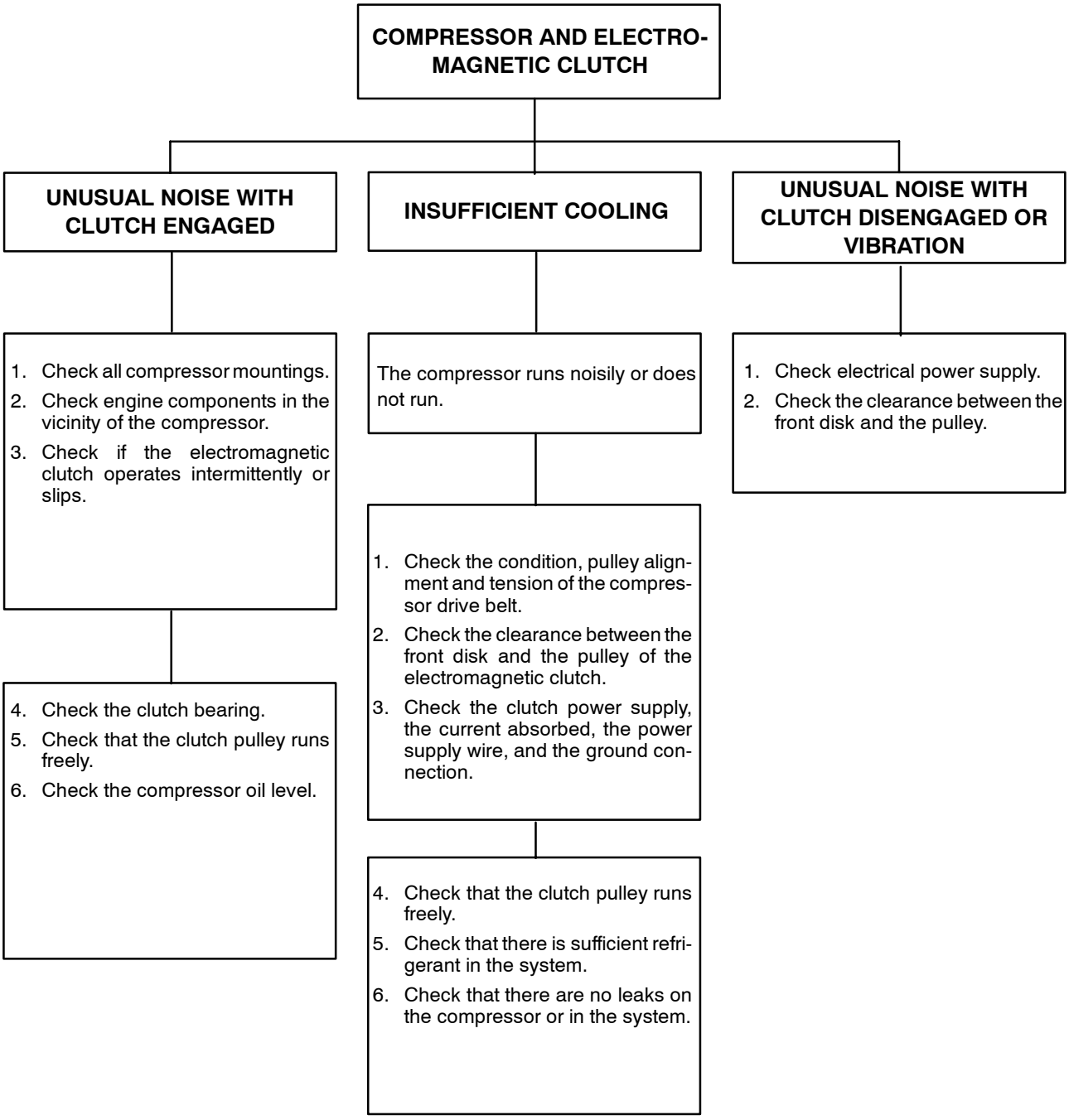
DISCHARGE PRESSURE NORMAL AND/OR SUCTION PRESSURE NORMAL-HIGH

ANTI-FROST SWITCH

With the outside temperature below 30° the electro-magnetic clutch is permanently engaged.

1. Check the anti-frost switch (1, fig. 6) as indicated on page 10.
2. Replace the anti-frost switch (1, fig. 6) if it does not function correctly, taking care not to crush the capillary tube. Install the new switch in exactly the same position in the evaporator as the switch that has been replaced.

AIR CONDITIONING SYSTEM TROUBLESHOOTING



Op. 50 200 03
CAB AIR CONDITIONING SYSTEM FUNCTIONAL TESTS

DANGER

Perform functional testing on the system following the safety regulations described on page 2.

With the pressure gauges connected to the system hoses on the:

Intake side of the compressor, (for low pressure testing/reading).

Delivery side of the compressor, (for high pressure testing/reading),

proceed as follows:

1. Start the engine and bring it up to a speed of 1500 rpm.

2. Set the electric fan (1, fig. 12) to maximum speed.

3. Press the push button (2, fig. 12) to switch on the air conditioning.

After the system has been in operation for about 15 minutes, check the following values:

4. Pressure on the suction side of the compressor, as indicated by the low pressure gauge.

5. Pressure on the delivery side of the compressor, as indicated by the high pressure gauge.

6. Ambient air temperature.

7. Ambient relative humidity.

8. Temperature of air leaving vents inside the cab.

The pressure values will depend on the external ambient conditions and the altitude, see the table on page 4.

The system is to be considered as functioning correctly if the pressure and temperature readings are within the value ranges indicated on page 3.

9. Carry out temperature checks on the high and low pressure parts of the system:

- all high pressure parts - from the compressor delivery fitting to the expansion valve installed on the evaporator unit - should be uniformly hot to touch;

- all low pressure parts, - from the evaporator outlet to the suction fitting on compressor - should be uniformly cold to touch. There should not be excessive condensation on the suction line and the compressor low pressure inlet.

10. The compressor should not be excessively noisy, there should be an audible click when the drive is engaged.

Checking the temperature of the air coming out of the vents inside the cab

If the temperature of the air measured at the vents inside the cab is within the value range indicated in the table for the external ambient air temperatures specified, the system is functioning efficiently.

If the air temperature at the vents is greater than the maximum temperature stated in the table, it is necessary to find the trouble as indicated on the following pages in order to make the system efficient.

VARIATIONS IN WORKING TEMPERATURES
OF THE CAB AIR CONDITIONING SYSTEM

External ambient temperature	68 °F (20 °C)	80.6 °F (27 °C)	82.4 °F (28 °C)	95 °F (35 °C)	96.8 °F (36 °C)	109.4 °F (43 °C)
Temperature of air at vent outlets (inside cab)	39.2 to 46.4 °F (4 to 8 °C)		42.8 to 53.6 °F (6 to 12°C)		53.6 to 68 °C (12 to 20 °C)	

Op. 50 200 06

CHECKING FOR AND REMOVING GAS LEAKS

with leak detector 380000314

DANGER

Perform functional testing on the system following the safety regulations described on page 2.

With the system charged, proceed as follows:

1. Start the engine.
2. Set the cab ventilation fan to maximum speed.
3. Press the push button (2, fig. 12) to switch on the air conditioning.
4. Bring the engine up to a speed of 1500 rpm.
5. Operate the electronic detector as described on page 16.
6. Move the probe around all pipe connections and all possible points of leakage:

- leaks are indicated by an increase in the frequency of the acoustic signal.

NOTE: *The refrigerant is heavier than air, therefore it will be easier to detect the leak point from below rather than from above.*

7. If leaks are found in the pipe connections, tighten the fittings in order to eliminate the leak.

CAUTION

If any of the system components need to be replaced, always follow the recovery, recycling and charging operations, using control unit 380000315.

Op. 50 200 10
COMPRESSOR DRIVE BELTS
Tension adjustment

CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing – safety goggles, gloves and shoes.

The condition of the belt transmitting drive from the engine to the compressor is particularly important as regards the correct operation of the air conditioning system.

This drive belt therefore requires careful attention, proceed as follows:

1. Fit the belt correctly.
2. Check the belt tension.
3. Check the condition of the belt.

Fitting the compressor drive belt

When first fitted, the belt must not be forced, pulled with a screwdriver, or rolled over the edge of the pulley: this would cause overstretching of the low deformation fabric and successive damage to the other fabrics.

New belts must be fitted at a higher tension than normal so as to compensate for the initial stretching as the belt is run in; this means that the belt must be re-checked after 50 hours of operation and adjusted to the normal tension.

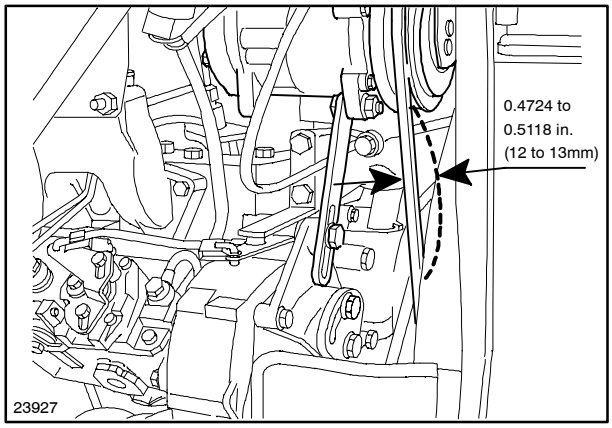
This check is very important as if the belt is left too taut, it could damage the pulley bearings and cause the premature deterioration of the belt itself.

If, on the other hand, the belt is too slack, it will start to slip and overheat and thus very rapidly deteriorate.

Checking compressor drive belt tension

Only check the tension when the belt is cold [below 104 °F (40 °C)].

Check the tension by applying a load of 78 to 98 N (8 to 10 kg) to the centre of the belt run, indicated in the figure, the belt should deflect by ≅ 0.4724 to 0.5118 in. (≅ 12 to 13 mm).



17

Periodic checking of drive belt

When checking the tension, also check the amount of drive belt wear.

The following cases may occur:

A. **Belt shiny:** belt sides worn to a smooth shine can cause slippage.

B. **Belt cracked:** may break suddenly due to splits on the inner surface caused by excessive flexure.

C. **Worn sides:** with the sides worn or the inner part cracked the belt could break at any moment.

D. **Belt impregnated with grease:** grease will cause the internal part of the belt to wear rapidly.

Take the following action:

A. If the belt squeaks when running, check the tension and adjust if necessary. If the noise continues, replace the belt.

B. If the belt is too slack, it will heat and stretch and, eventually, overheat. When this occurs, replace the belt.

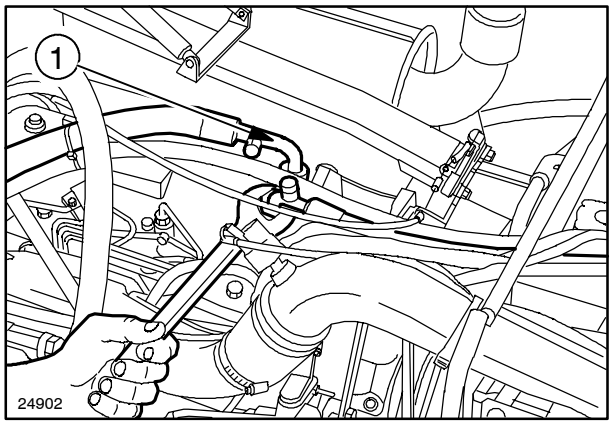
C. If the belt has deep cracks, or has been excessively stretched and cannot be tensioned correctly, replace the belt.

Op. 50 200 26
AIR CONDITIONER COMPRESSOR R.I.

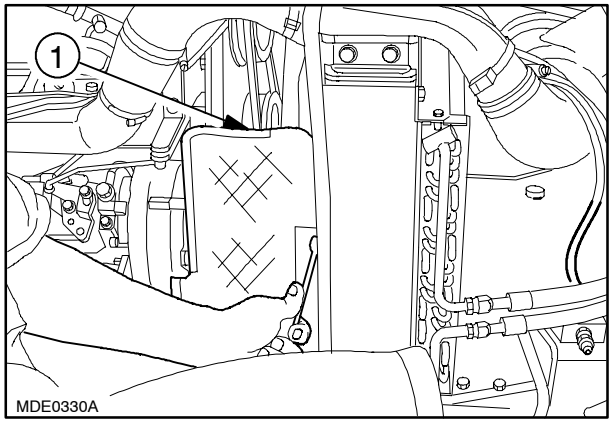
DANGER

Recover the refrigerant closely following the safety regulations described on page 2.

1. Recover the refrigerant from the system using control unit **380000315**.
2. Detach the exhaust pipe and raise the bonnet.
3. Disconnect the battery negative cable.
4. Remove the filter/dryer as described on page 37 and the hoses (1) from the compressor.
5. Unscrew the right-hand lateral guard retaining bolts (1).

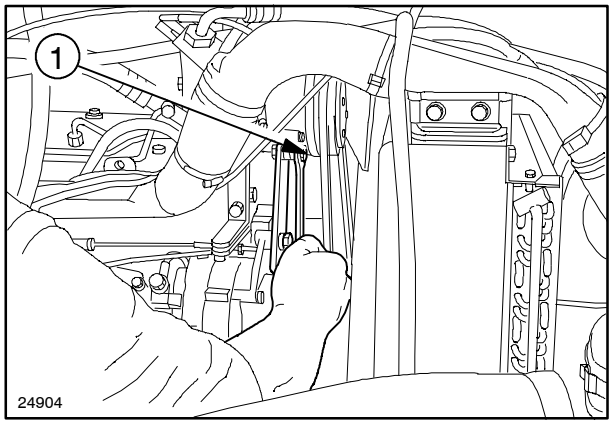


18



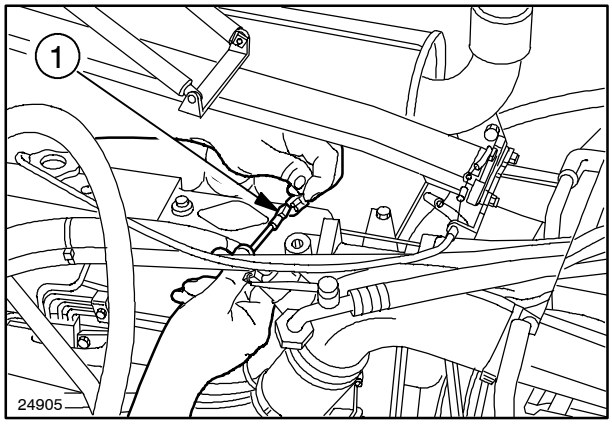
19

6. Unscrew the two nuts (1) securing the compressor unit chain tensioner bracket and remove the bracket.



20

7. Disconnect the compressor ground connection (1).



21

8. Loosen the bolt (1) securing the compressor to the engine and extract the belt from the pulley.

9. Take out the bolt securing the compressor, previously loosened, and remove the compressor (1, fig. 23).

10. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refit the compressor, the belt tensioner support bracket and reconnect the ground connection.
- Reassemble the right-hand guard.
- Reconnect the two air conditioner hoses on the compressor.
- Connect the battery negative lead.
- Empty and charge the system with HFC 134a gas, using control unit **380000315**.
- Close the hood and refit the exhaust pipe.

COMPRESSOR OIL - TYPE AND QUANTITY

The tractor is equipped with a SANDEN SD 7H15 for refrigerant.

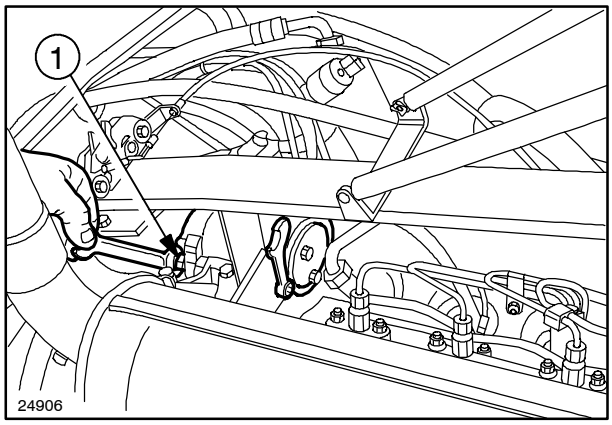
After assembly, the compressor is filled with 185 cm^3 of PAG SP20 lubricating oil.

In case of top up or oil change only use this type of oil.

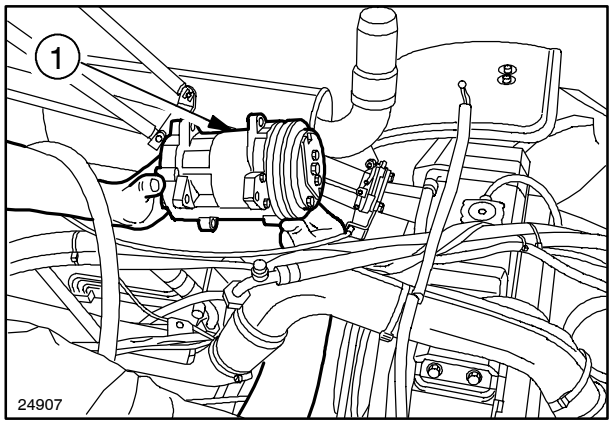
It is not necessary to check the compressor oil level unless the system develops significant gas leaks.

CAUTION

If the system develops significant gas leaks there will also be significant oil leaks from the PAG SP20 compressor.
It will therefore be necessary to check the compressor oil level, remembering that of the total quantity of lubricating oil (185 cm^3) on average only 130 to 135 cm^3 will be present in the compressor, whilst the remaining (50-55 cm^3) will be in circulation through the various system components.
For problems of this type, we recommend that you seek assistance from an authorised CNH service centre.



22



23

Op. 50 200 40
HEATING PIPES
Replacement

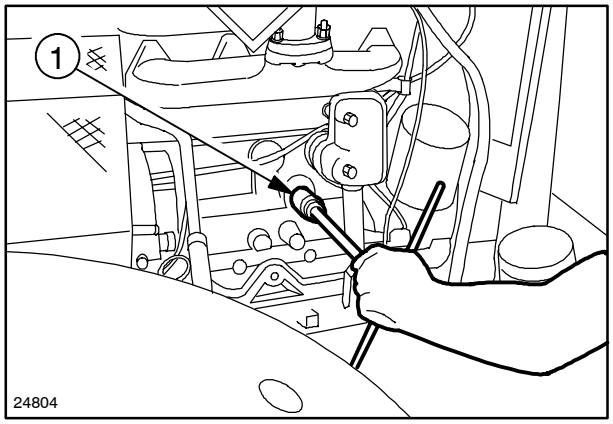
DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that the load is supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

DANGER

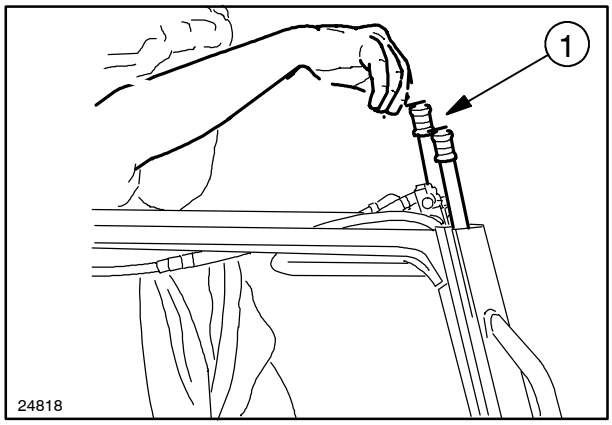
Recover the refrigerant closely following the safety regulations described on page 2.

1. Perform the disassembly sequences 1 to 18 described in operation **50 200 60** for the **AIR-CONDITIONING PIPES.**



24

2. Remove the two heater water supply and return pipes (1), extracting them from the top of the left-hand duct in the cab.



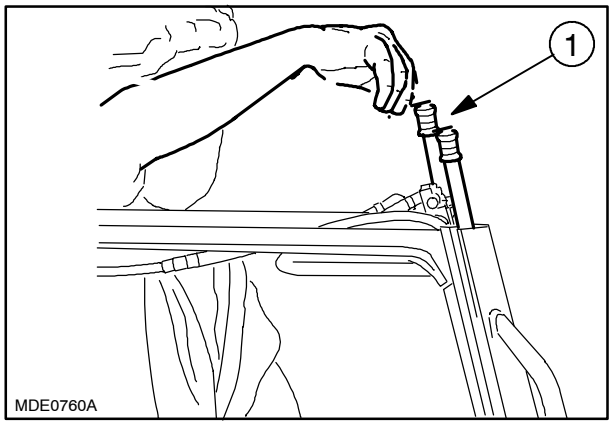
25

3. Before assembly, thoroughly clean the parts and proceed as follows:

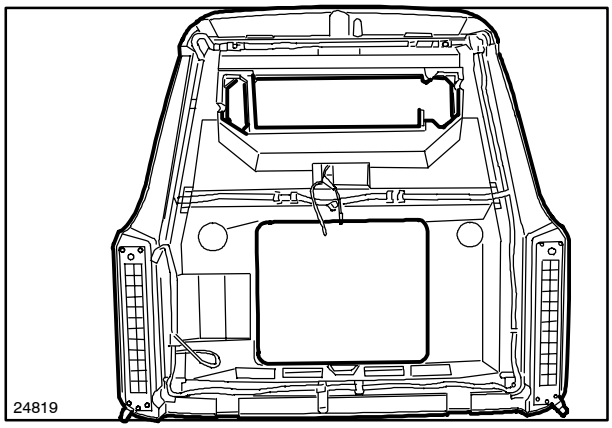
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Insert the two new heater water supply and return hoses (1) into the left-hand duct in the cab upright.
- Remove all traces of the old seal and apply a suitable sealing compound together with the new "tarred" seal, as shown in fig. 27.
- Sling the roof with a cable, raise and reposition the roof on the uprights. Check that the seal is correctly positioned and secure the roof with the eight retaining bolts.
- Reconnect the three plug connections to the fan / air-conditioning control unit.
- Reconnect the electrical connections to the fan unit.
- Reconnect the electrical connections to the thermostatic sensor.
- Reassemble the two condensate discharge hoses.
- Refit the cab heating hoses (left-hand upright).
- Reinsert the two rigid copper pipes in the expansion valve. Attach the air-conditioning pipes to the valve using the slotted plate.
- Insert the delivery/return pipe in the brass sleeve on the evaporator and secure with the two metal clips.
- Carry out the assembly sequences described in operation **90 160 60** for the **CAB CEILING TRIM**.
- Fit the evaporator cover and the four retaining bolts back on.
- Refit the roof hatch.
- Top up the radiator with the liquid that was previously drained off.
- Fill the air conditioning circuit with HFC 134 a gas, using control unit **380000315**.



26



27

Op. 50 200 60
AIR-CONDITIONING PIPES
Replacement

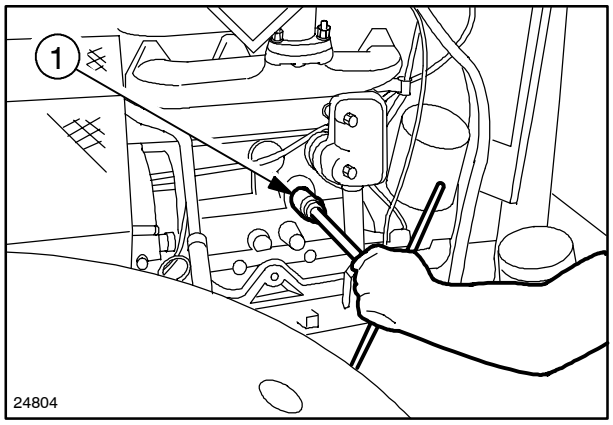
DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that the load is supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

DANGER

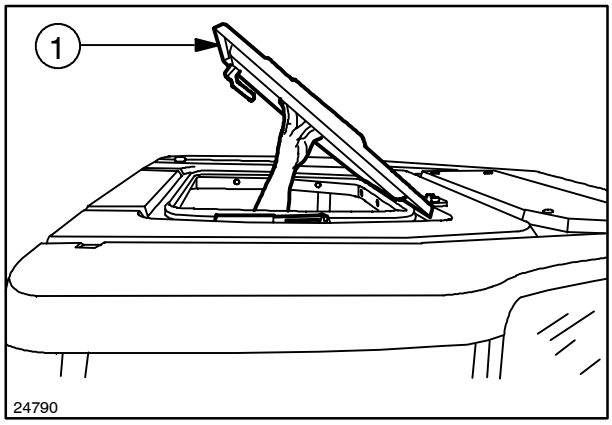
Recover the refrigerant closely following the safety regulations described on page 2.

1. Recover the refrigerant using control unit **380000315**.
2. Drain off approximately three litres of refrigerant from the plug (1) on the engine block.



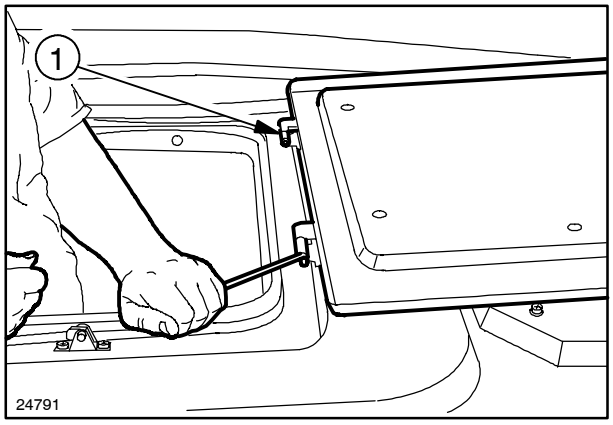
28

3. Open the roof hatch (1) extracting the pneumatic pistons.



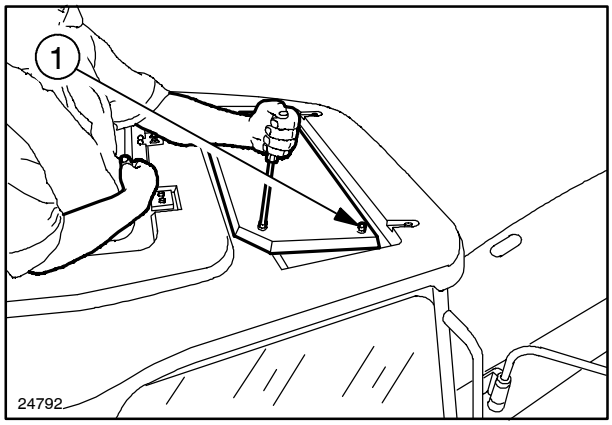
29

4. Remove the pivot pins (1) and remove the hatch.



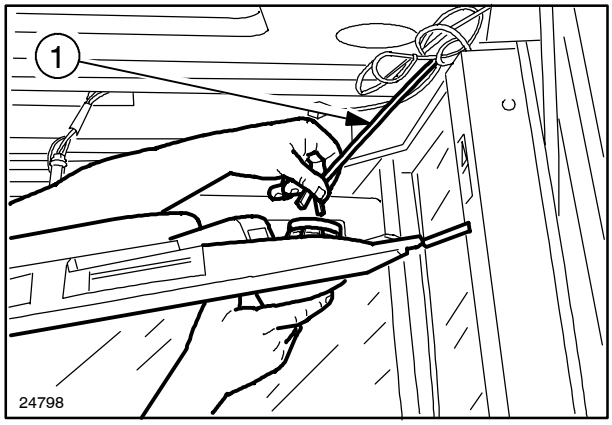
30

5. Unscrew the four bolts (1) securing the evaporator cover.



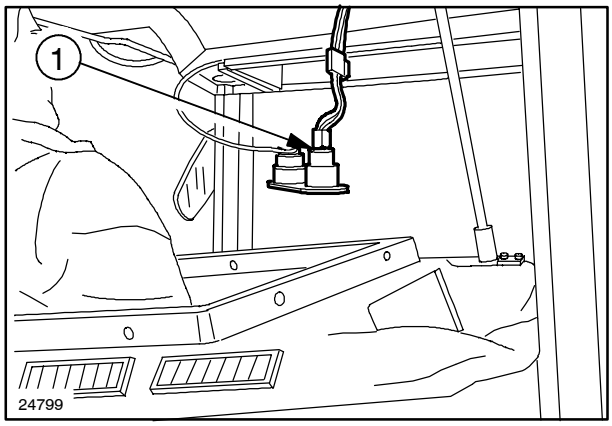
31

6. Carry out the disassembly sequences described in operation **90 160 60** for the **CAB CEILING TRIM**.
7. Disconnect the loudspeaker wires (1).



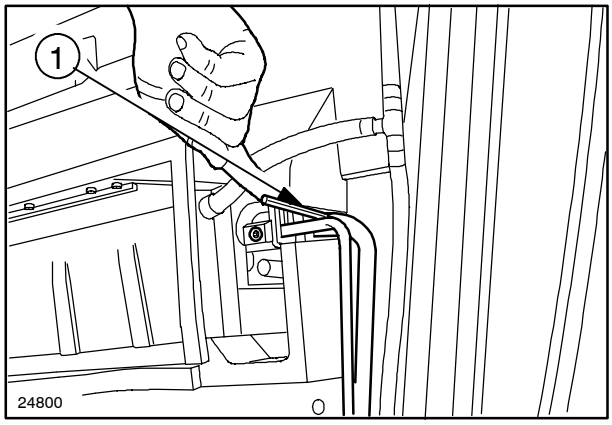
32

8. Unscrew the retaining screw and extract the fan control unit (1).



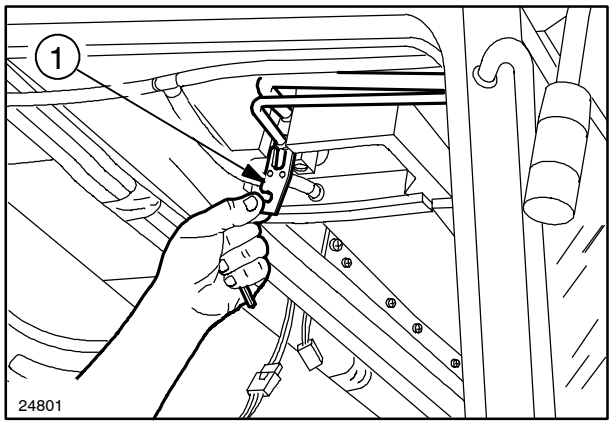
33

9. Unscrew the two bolts (1) clamping the rigid pies to the evaporator.



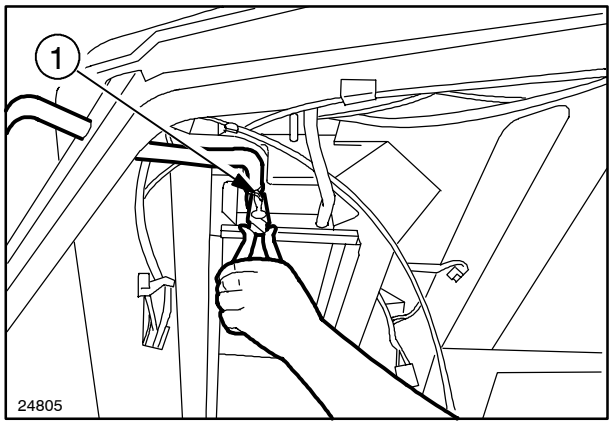
34

10. Remove the clamp (1) and extract the pipes.



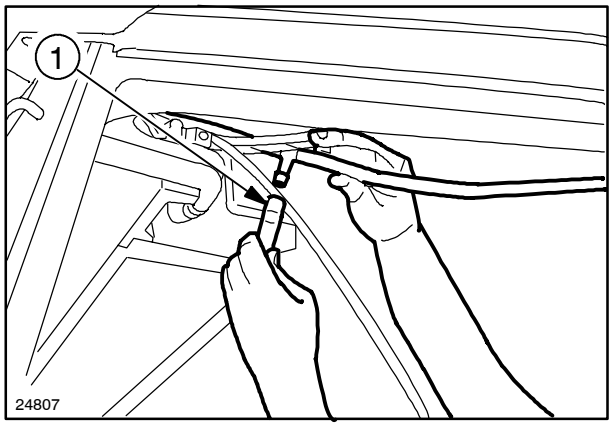
35

11. Detach the two clips (1) holding the hoses and extract the hoses from the heater.



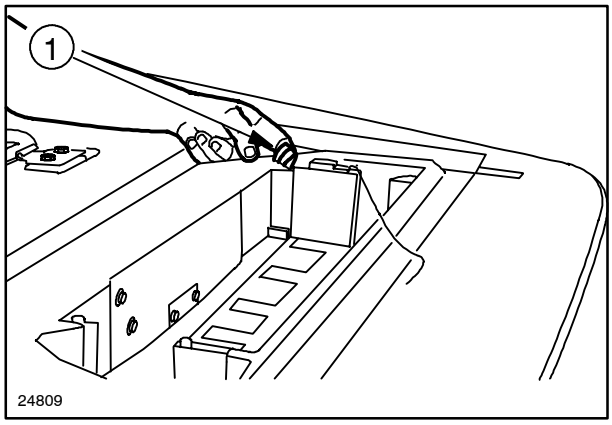
36

12. Detach the two condensate drainage hoses (1).



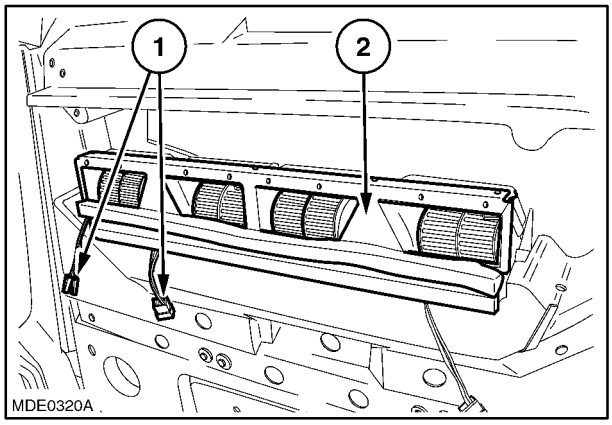
37

13. Disconnect the electrical connections (1) on the temperature sensor.



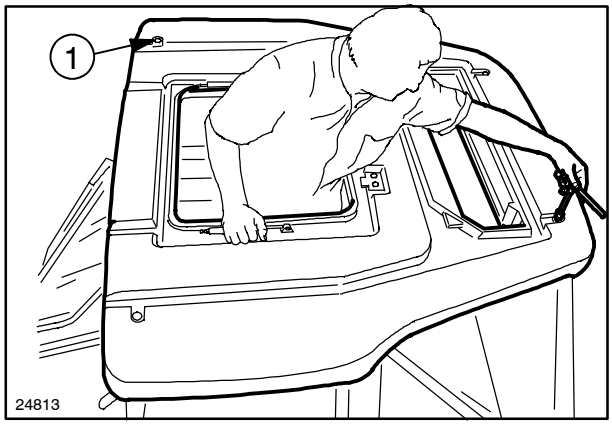
38

14. Disconnect the electrical connections (1) on the fan unit (2).



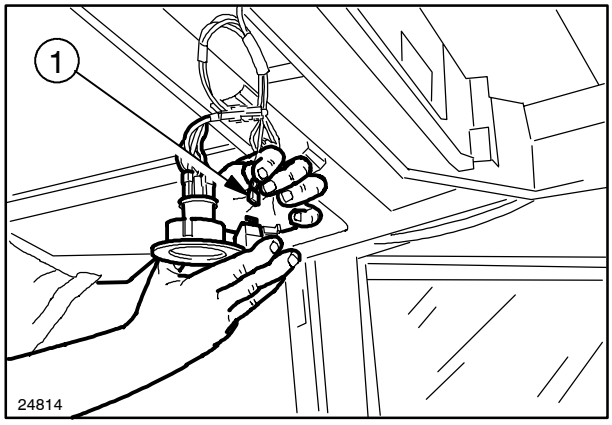
39

15. Unscrew the eight bolts (1) securing the cab roof.



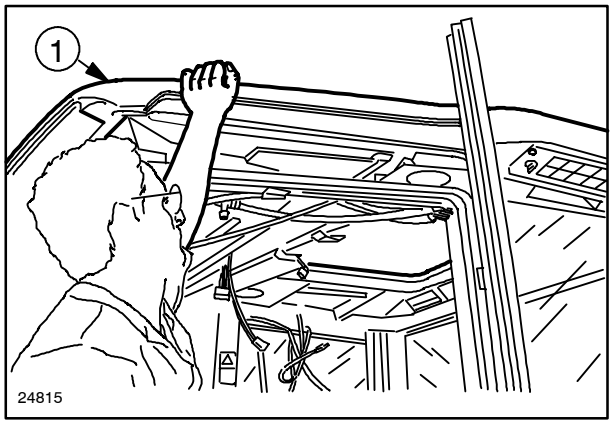
40

16. Disconnect the three connections (1) on the air conditioning control unit, located on the central crosspiece.



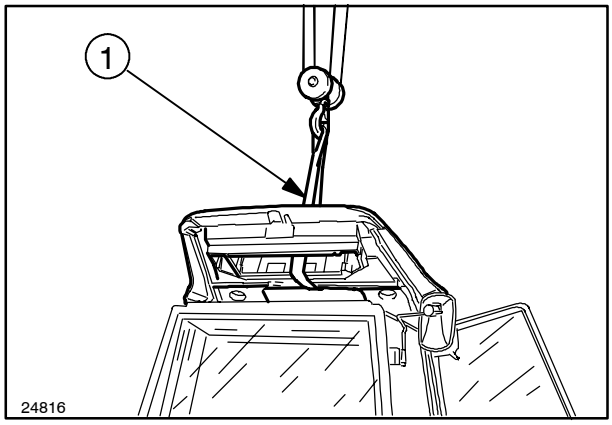
41

17. Remove the roof (1) from the support uprights.



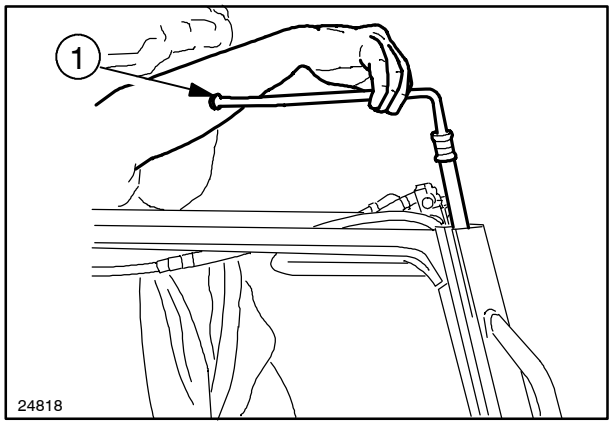
42

18. Using slings (1) hitch the roof and raise with a hoist.



43

19. Remove the air conditioning feed and return lines (1), extracting from the upper part of the cab right-hand upright.



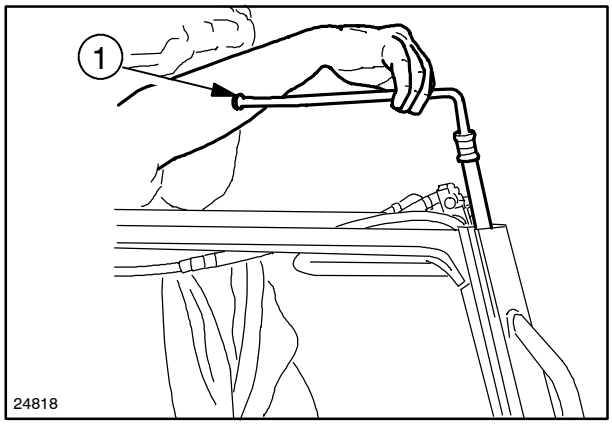
44

20. Before assembly, thoroughly clean the parts and proceed as follows:

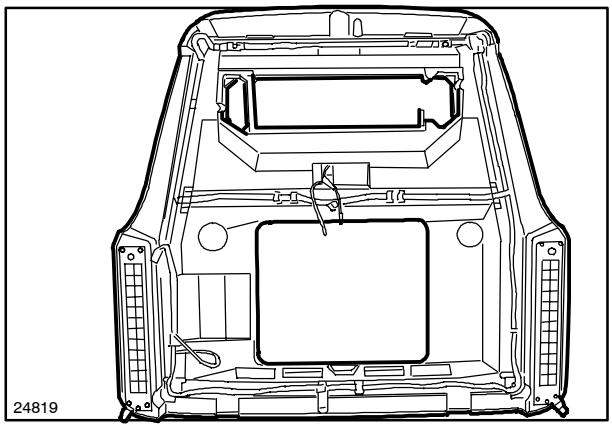
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Insert the two new air conditioning supply and return hoses (1) into the right-hand duct in the cab upright.
- Remove all traces of the old seal and apply a suitable sealing compound together with the new "tarred" seal, as shown in fig. 46.
- Hitch the roof with a cable, raise and reposition the roof on the uprights. Check that the seal is correctly positioned and secure the roof with the eight retaining bolts.
- Reconnect the three plug connections to the fan / air-conditioning control unit.
- Reconnect the electrical connections to the fan unit.
- Reconnect the electrical connections to the thermostatic sensor.
- Reassemble the two condensate discharge hoses.
- Refit the cab heating hoses (left-hand upright).
- Reinsert the two rigid copper pipes in the expansion valve. Attach the air-conditioning pipes to the valve using the slotted plate.
- Insert the delivery/return pipe in the brass sleeve on the evaporator and secure with the two metal clips.
- Carry out the assembly sequences described in operation **90 160 60** for the **CAB CEILING TRIM**.
- Fit the evaporator cover and the four retaining bolts back on.
- Refit the roof hatch.
- Top up the radiator with the liquid that was previously drained off.
- Fill the air conditioning circuit with HFC 134 a gas, using control unit **380000315**.



45



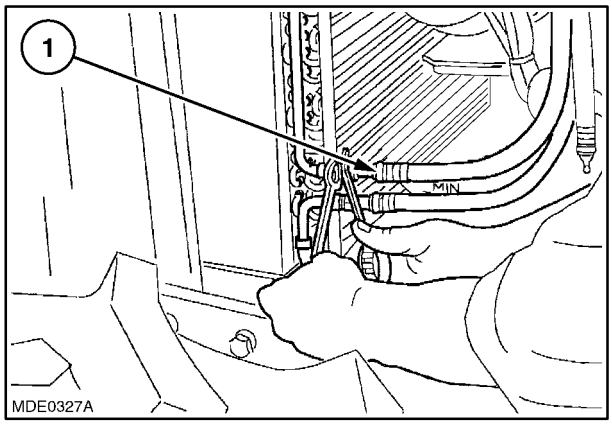
46

Op. 50 200 72
AIR CONDITIONER CONDENSER
Replacement

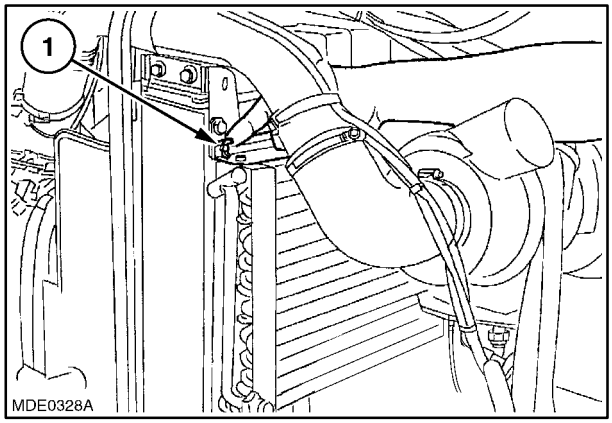
DANGER

Recover the refrigerant closely following the safety regulations described on page 2.

1. Recover the refrigerant using control unit **380000315**.
2. Disconnect the two gas delivery and return hoses (1) on the condenser.
3. Unscrew the butterfly nut (1) securing the condenser.

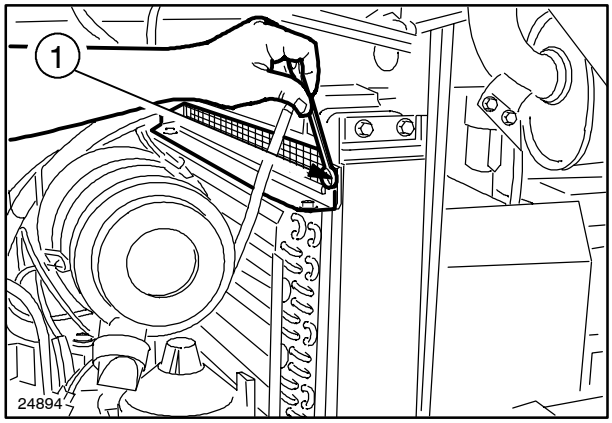


47



48

4. For tractors with front mudguards, unscrew the two bolts (1) securing the condenser upper guide (for tractors without front mudguards turn the steering wheel fully to the right and extract the condenser radiator on the right-hand side of the tractor).
5. For tractors with front mudguards, remove the condenser unit (1, fig. 50) and relative guide.



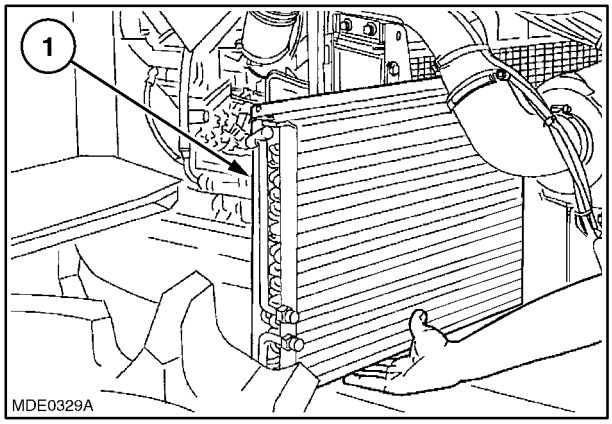
49

6. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refit the condenser and relative guide, secure in position with the wing nut and bracket and tighten the two bolts.
- Refit the two hoses on the condenser.
- Empty and charge the system with HFC 134a gas, using control unit **380000315**.
- Close the hood and refit the exhaust pipe.



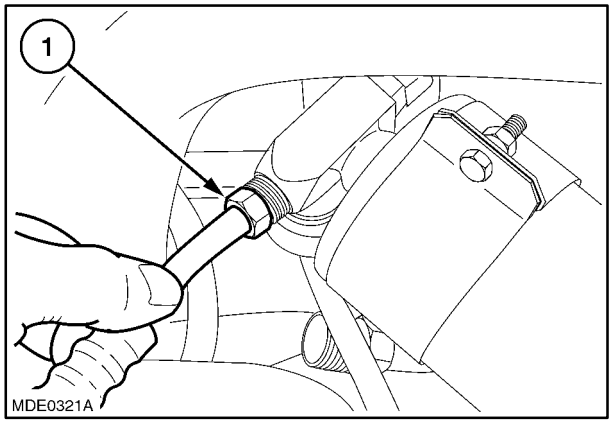
50

Op. 50 200 74
FILTER/DRYER
Replacement

DANGER

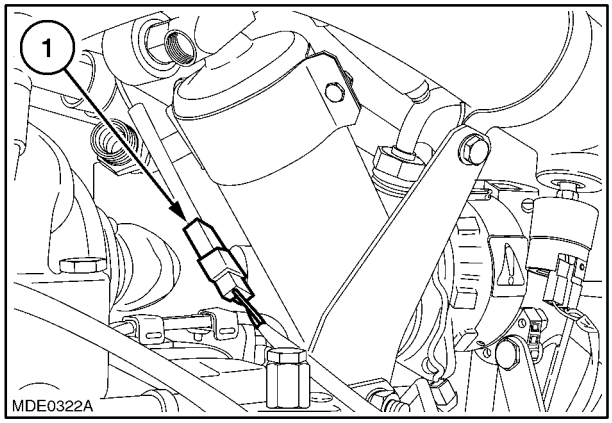
Recover the refrigerant closely following the safety regulations described on page 2.

1. Recover the refrigerant from the system using control unit **380000315**.
2. Detach the exhaust pipe and raise the bonnet.
3. Detach the hose (1) connecting the condenser to the filter/dryer.



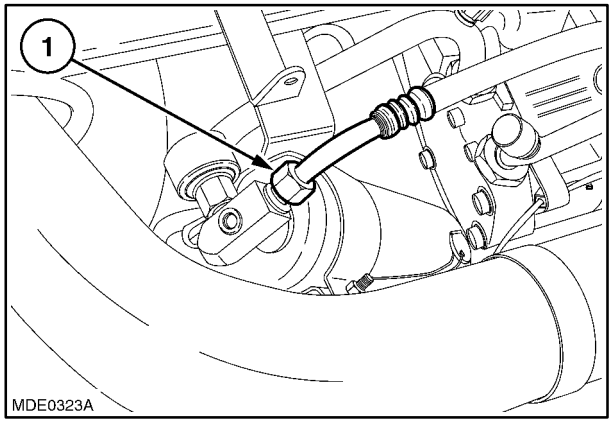
51

4. Disconnect the electrical connection (1) on the filter/dryer.



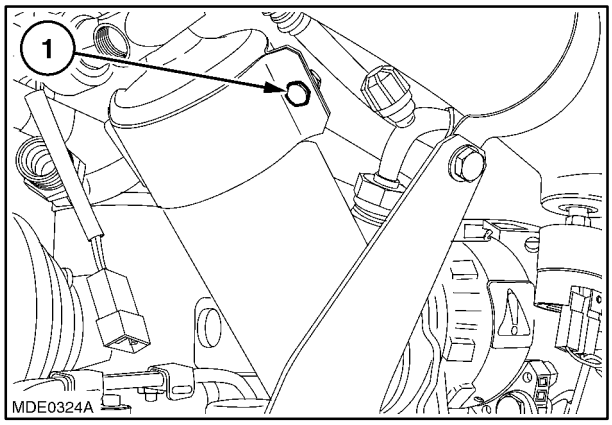
52

5. Detach the hose (1) connecting the filter/dryer to the vaporizer.



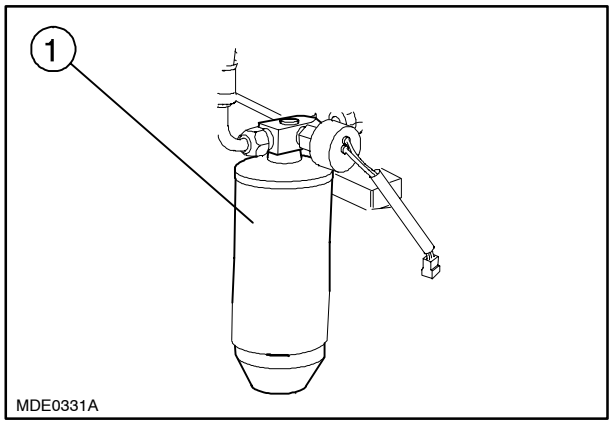
53

6. Unscrew the bolt (1) securing the filter/dryer clamp.



54

7. Remove the filter/dryer assembly (1).



55

8. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refit the filter/dryer on the support bracket.
- Reconnect the delivery and return hoses and the filter electrical connections.
- Empty and charge the air conditioning system with HFC 134a gas, using control unit **380000315**.
- Close the hood and refit the exhaust pipe.

Op. 50 206 50
CAB HEATING UNIT R.I.

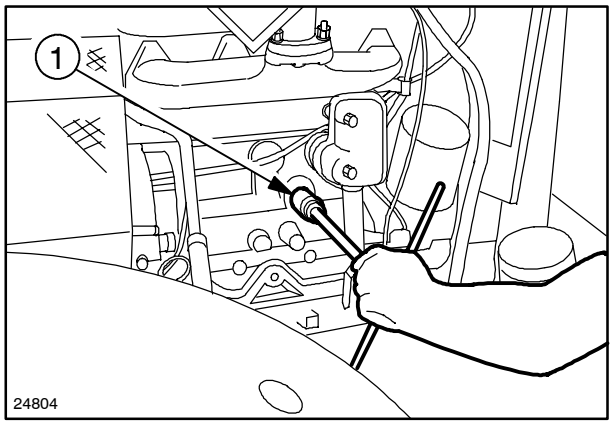
CAUTION

Handle all parts carefully.

Do not put your hands or fingers between parts.

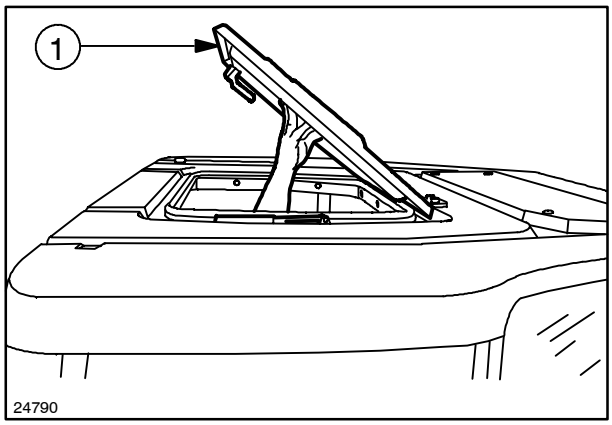
Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Drain off approximately three litres of refrigerant from the plug (1) on the engine block.



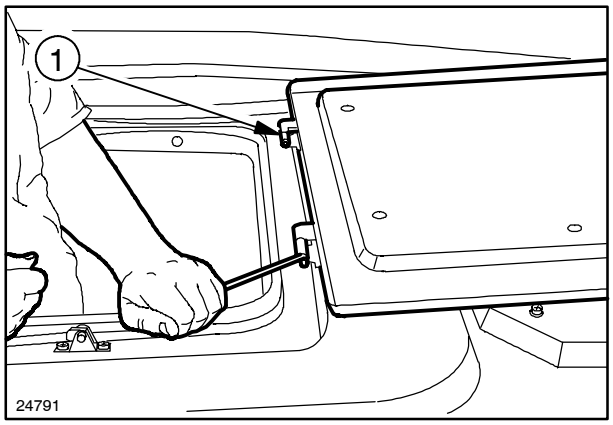
56

2. Open the roof hatch (1) extracting the pneumatic pistons.



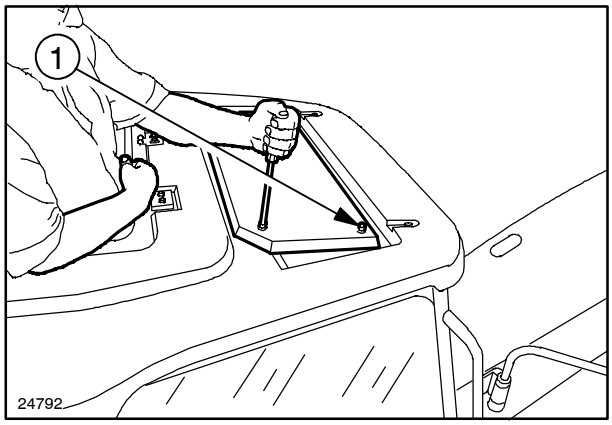
57

3. Remove the pivot pins (1) and remove the hatch.



58

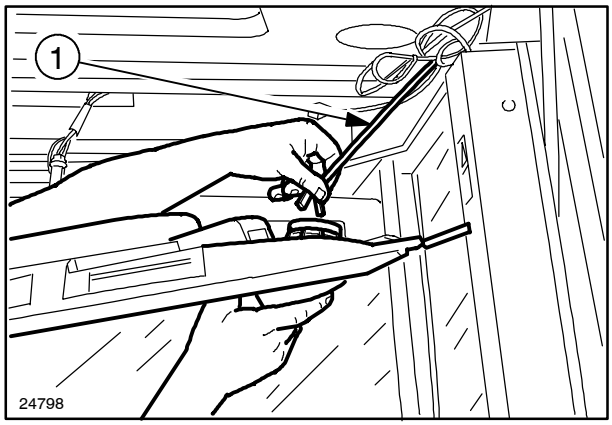
4. Unscrew the four bolts (1) securing the evaporator cover.



59

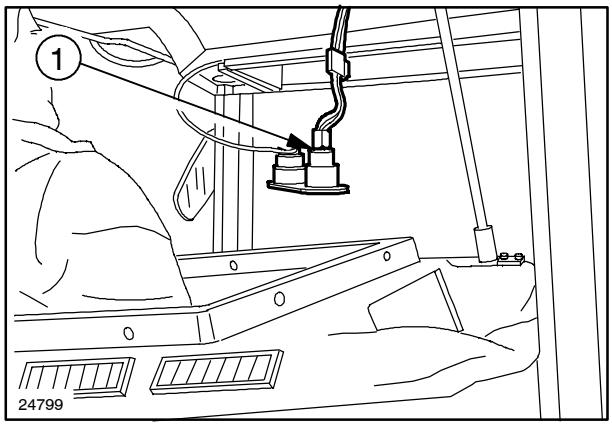
5. Carry out the disassembly sequences described in operation **90 160 60** for the **CAB CEILING TRIM**.

6. Disconnect the loudspeaker wires (1).



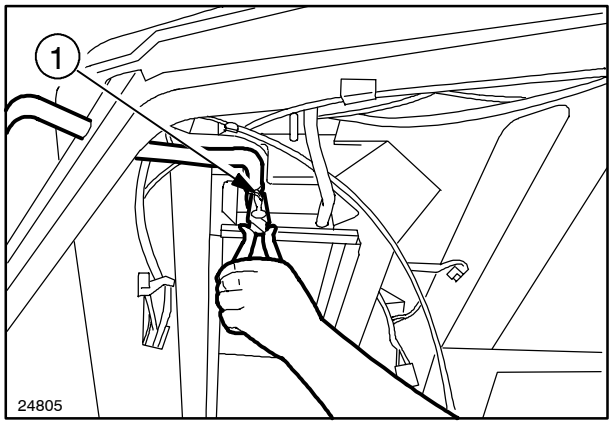
60

7. Unscrew the retaining screw and extract the fan control unit (1).



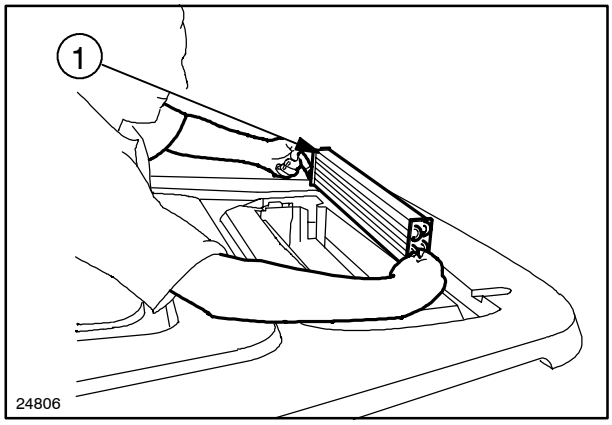
61

8. Detach the two clips (1) holding the hoses and extract the hoses from the heater.



62

9. Remove the heating unit (1) from above.



63

10. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Fit the heating unit at the top of the cab roof.

- Fit the rubber hoses on the heater and refit the two retaining clips.

- Mount the fan control unit and fit the retaining bolts.

- Connect the leads to the speakers.

- Carry out the assembly sequences described in operation **90 160 60** for the **CAB CEILING TRIM**.

- Fit the evaporator cover and the four retaining bolts on.

- Fit on the hatch, pneumatic pistons and pivot pins.

- Charge with the refrigerant previously discharged from the engine block.

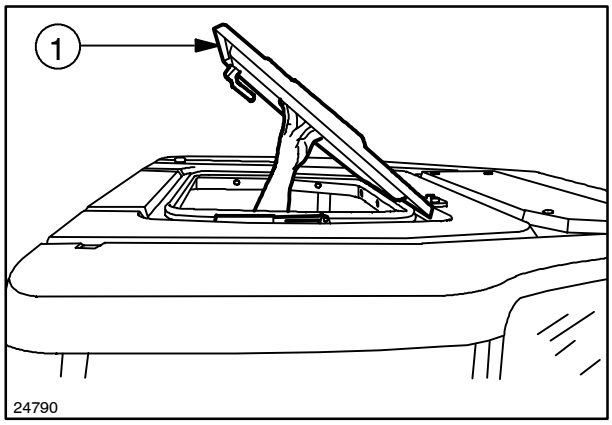
Op. 50 206 56
AIR CONDITIONER EVAPORATOR
Replacement

DANGER

Recover the refrigerant closely following the safety regulations described on page 2.

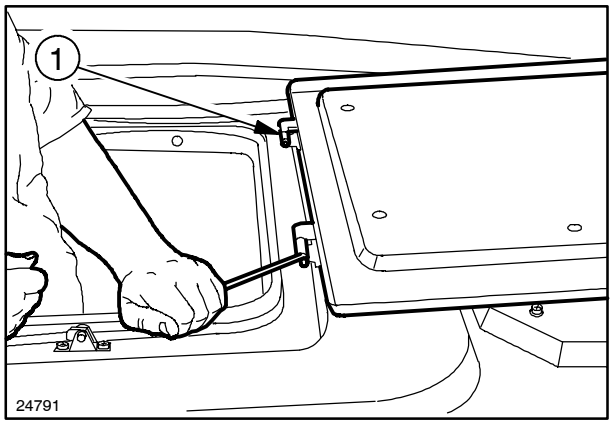
1. Recover the refrigerant using control unit **380000315**.

2. Open the roof hatch (1) extracting the pneumatic pistons.



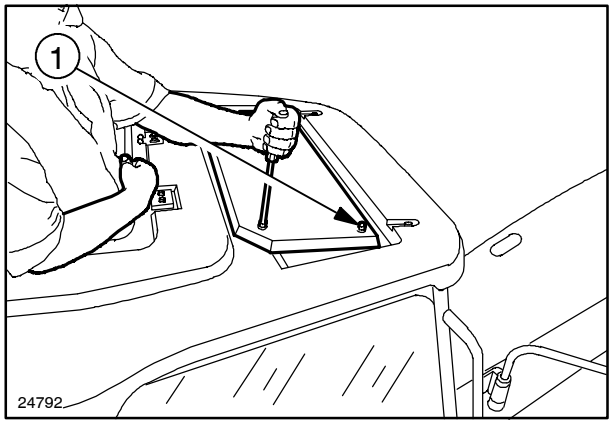
64

3. Remove the pivot pins (1) and remove the hatch.



65

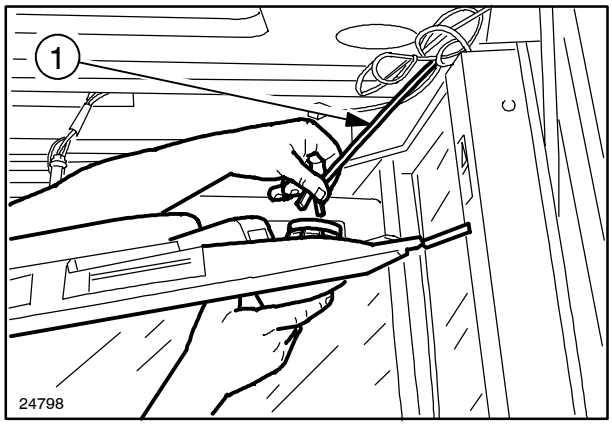
4. Unscrew the four bolts (1) securing the evaporator cover.



66

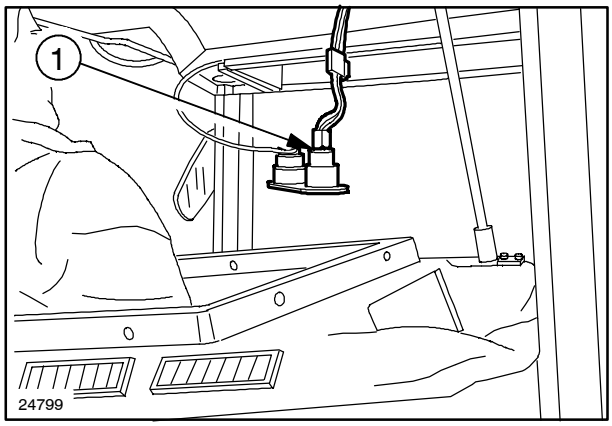
5. Carry out the disassembly sequences described in operation **90 160 60** for the **CAB CEILING TRIM**.

6. Disconnect the loudspeaker wires (1).



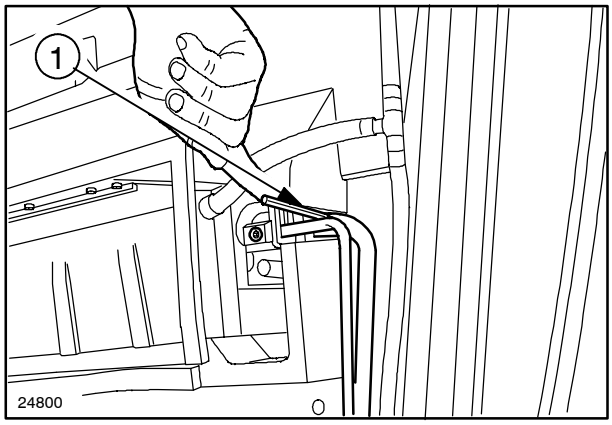
67

7. Unscrew the retaining screw and extract the fan control unit (1).



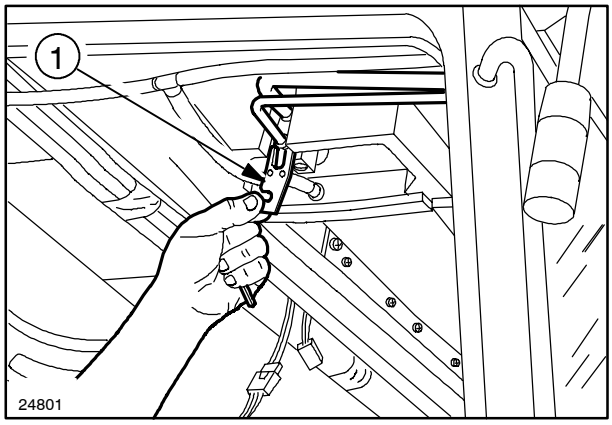
68

8. Unscrew the two bolts (1) clamping the rigid pies to the evaporator.



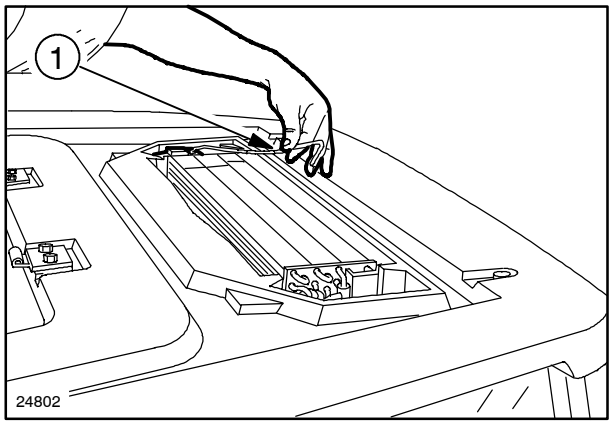
69

9. Remove the clamp (1) and extract the pipes.



70

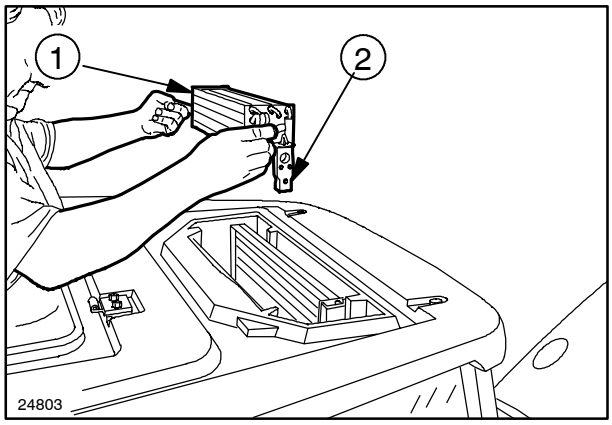
10. Extract the thermostatic sensor (1) from the evaporator fins.



71

11. Extract the evaporator (1) with the expansion valve (2).

NOTE: *The expansion valve (2) can be removed without extracting the evaporator.*



72

12. To assemble, proceed as follows:

⚠ CAUTION ⚠

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

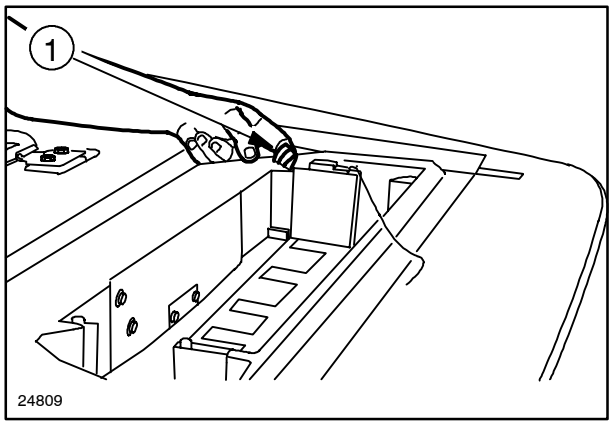
- Fit on the evaporator with the expansion valve.
- Fit the thermostatic sensor on the evaporator fins.
- Fit on the pipes, retaining plate and the two bolts securing it to the evaporator.
- Mount the fan control unit and fit the retaining bolts.
- Connect the leads to the speakers.
- Carry out the assembly sequences described in operation **90 160 60** for the **CAB CEILING TRIM**.
- Fit the evaporator cover and the four retaining bolts on.
- Fit on the hatch, pneumatic pistons and pivot pins.
- Charge the system with refrigerant using control unit **380000315**.

Op. 50 206 66
ELECTRIC FAN R.I.

DANGER

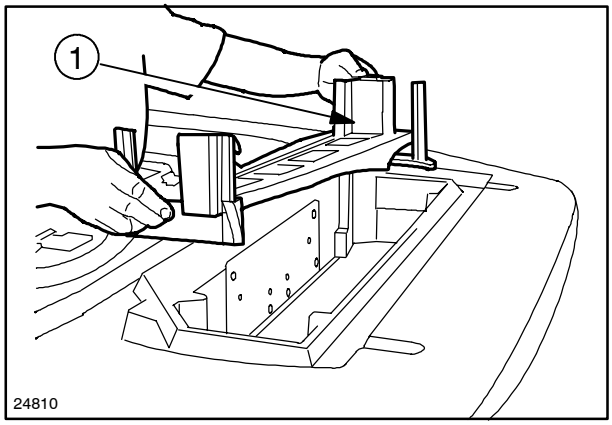
Recover the refrigerant closely following the safety regulations described on page 2.

1. Carry out the removal sequences described in operation **50 206 50** for the **CAB HEATING UNIT** and the disassembly sequences described in operation **50 206 56** for the **AIR CONDITIONER EVAPORATOR UNIT**.
2. Disconnect the electrical connections (1) on the temperature sensor.



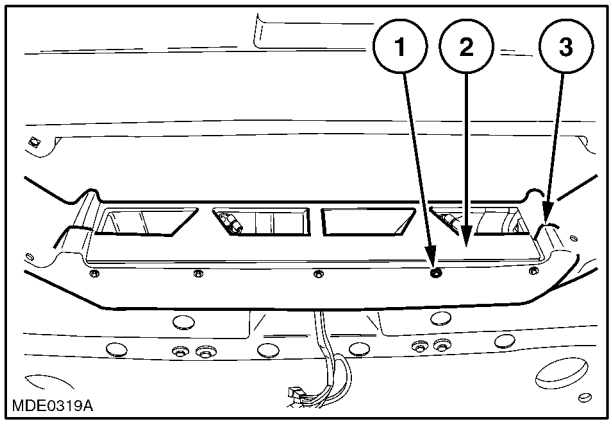
73

3. Remove the evaporator-heater support (1).



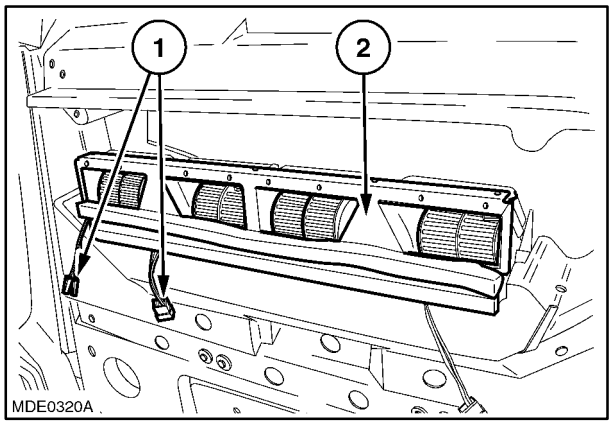
74

4. Unscrew the bolts (1) securing the fan unit (2) to the cab roof (3).



75

5. Disconnect the electrical connections (1) and remove the fan unit (2).



76

6. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Reconnect the electrical connections then the fan unit to the cab roof with the retaining bolts.

- Refit the evaporator-heater support and reconnect the electrical connections on the temperature sensor.

- Carry out the installation sequences described in operation **50 206 50** for the **CAB HEATING UNIT** and the assembly sequences described in operation **50 206 56** for the **AIR CONDITIONER EVAPORATOR UNIT**.

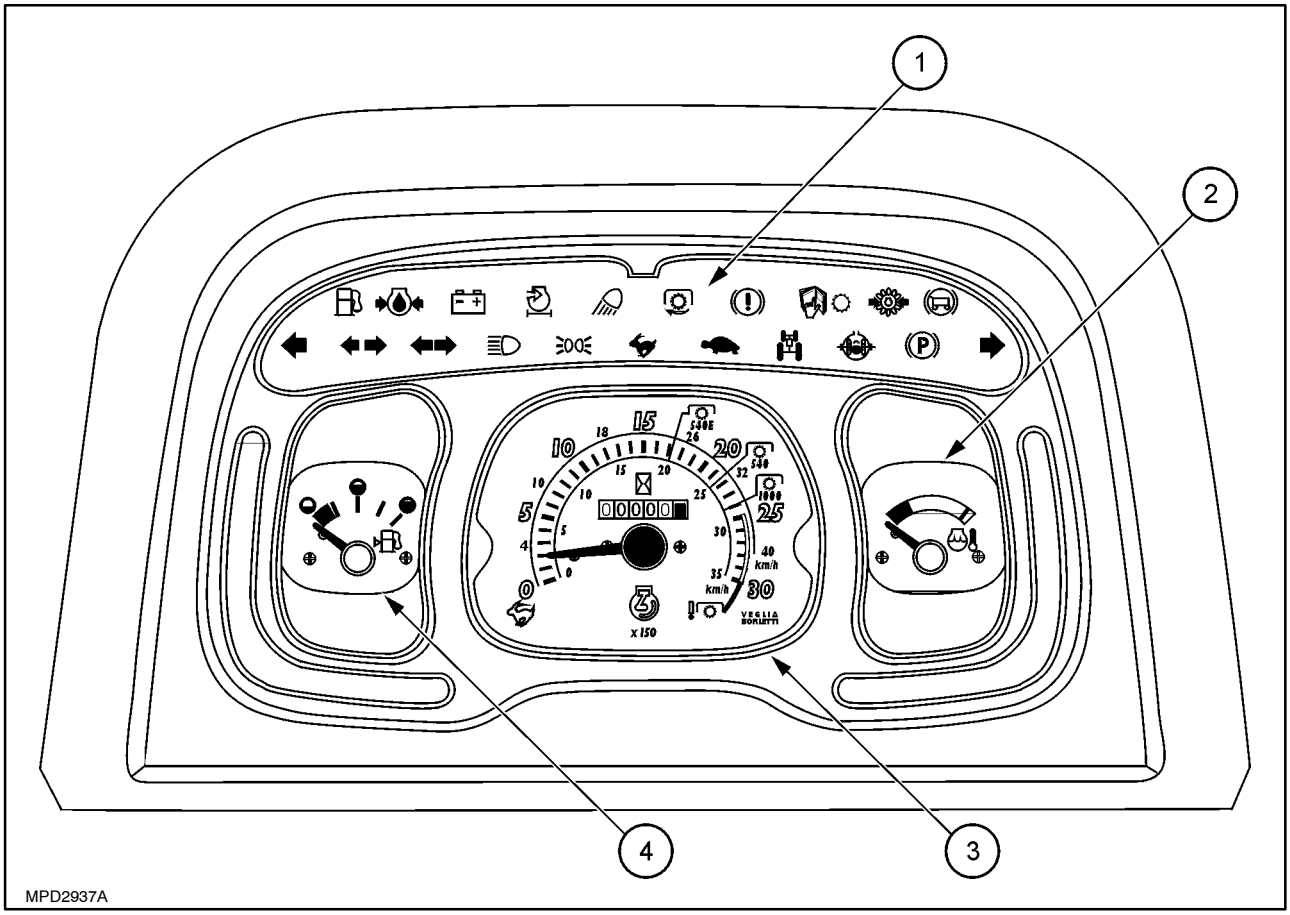
SECTION 55 - ELECTRICAL SYSTEM

Chapter 1 - INSTRUMENTS
(version from frame no. 1266941 for models with cab, from frame no. 1268756 for models with platform)

CONTENTS

Section	Description	Page
55418	Analog instruments	1
	Transmitters, sensors and switches	4
	Maintenance	12
	Electronic instruments	13
	Diagnostics	17

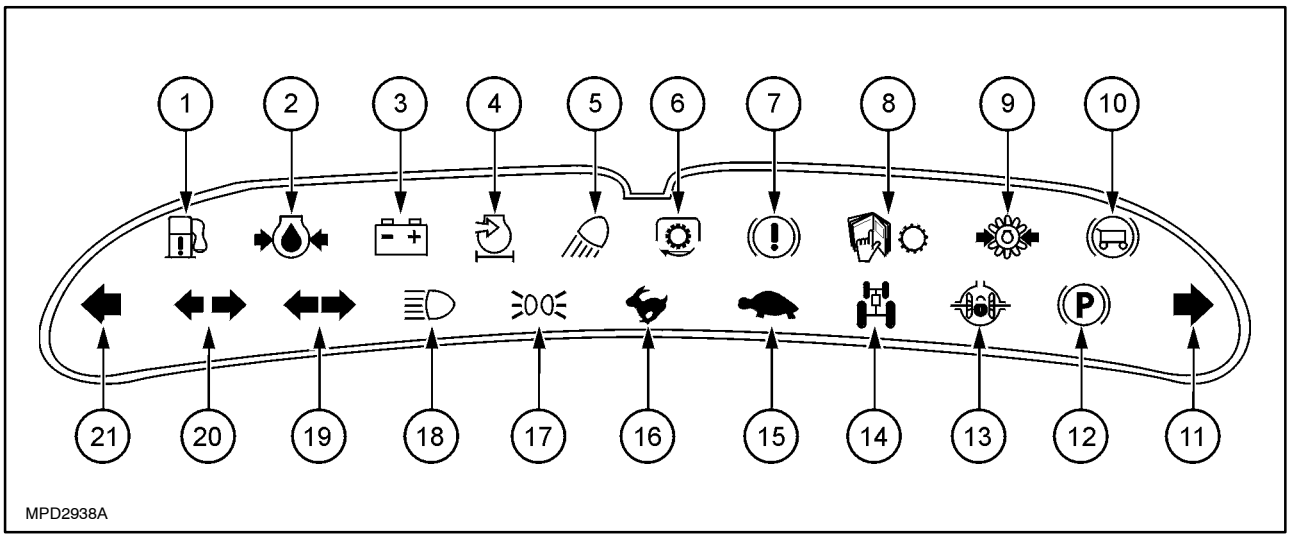
55 100 ANALOG INSTRUMENTS



1

The analog instrument panel is composed of four display sections:

1. alarm and on/off indicator lights;
2. engine coolant temperature indicator;
3. speedometer/tachometer;
4. fuel gauge.



2

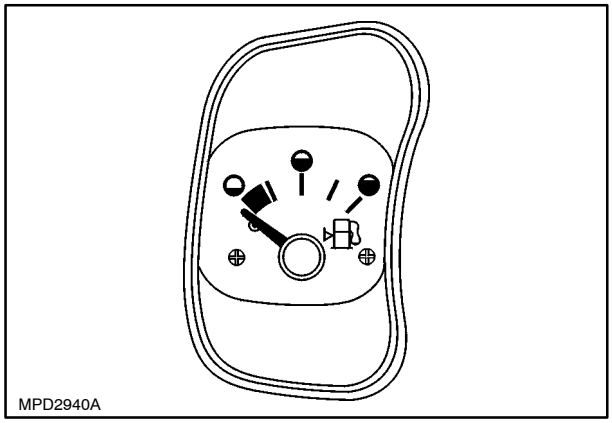
	Condition	Indicator
1.	Water in fuel indicator	On steady (red)
2.	Low engine oil pressure	On steady (red)
3.	Low battery charge	On steady (red)
4.	Air filter clogged	On steady (yellow)
5.	Work lights	On steady (yellow)
6.	PTO ON	On steady (yellow)
7.	Brake fluid level low	On steady (red)
8.	Power Shuttle alarm	On steady (red)
9.	Dual Command (2 Speed Power Shift) rear transmission oil pressure low	On steady (red)
10.	Trailer brake ON	On steady (red)
11.	Right-hand turn signal	Flashing (green)
12.	Handbrake ON (with starter key inserted)	On steady (red)
13.	Differential lock ON	On steady (yellow)
14.	4WD ON	On steady (green)
15.	Low gear range ON [with Dual Command (2 Speed Power Shift)]	On steady (yellow)
16.	High gear range ON [with Dual Command (2 Speed Power Shift)]	On steady (green)
17.	Side/tail lights	On steady (green)
18.	Full beam headlights	On steady (blue)
19.	Second trailer direction indicator	Flashing (green)
20.	First trailer direction indicator	Flashing (green)
21.	Left-hand turn signal	Flashing (green)

Fuel gauge (Fig. 3)

It shows the fuel level in the tank separately.

When the tank is full, the pointer moves completely to the right.

When the fuel level falls below 1/4, the needle moves into the red area.



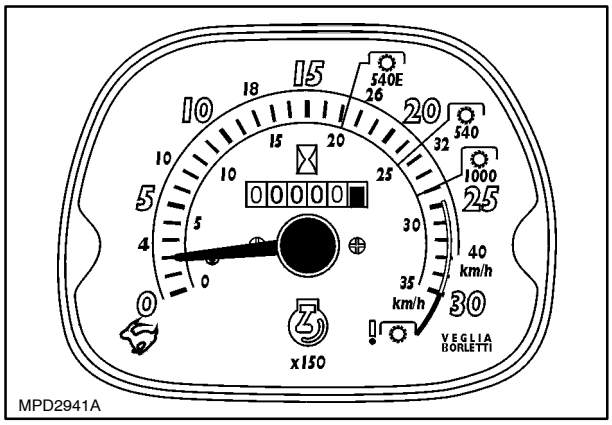
3

Speedometer/tachometer (Fig. 4)

This shows engine rpm and total time to a maximum of six digits: the figures on the black background total the working hours and those on the red background (to the extreme right) tenths of an hour.

The green and blue sectors show the engine speeds for optimum power take-off, respectively 540, 750 and 1000 rpm.

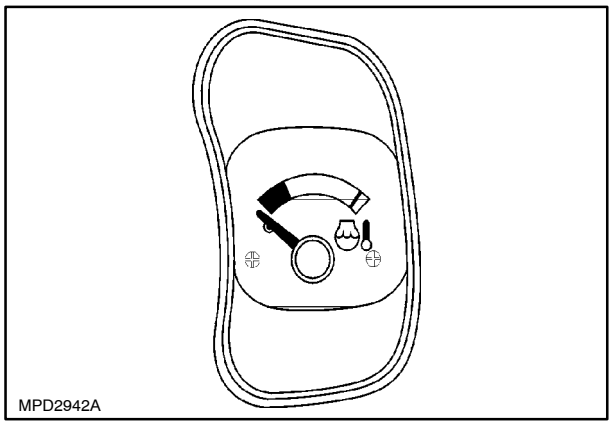
- Green mark = PTO at 540 rpm
- Blue mark = PTO at 750 and 1000 rpm



4

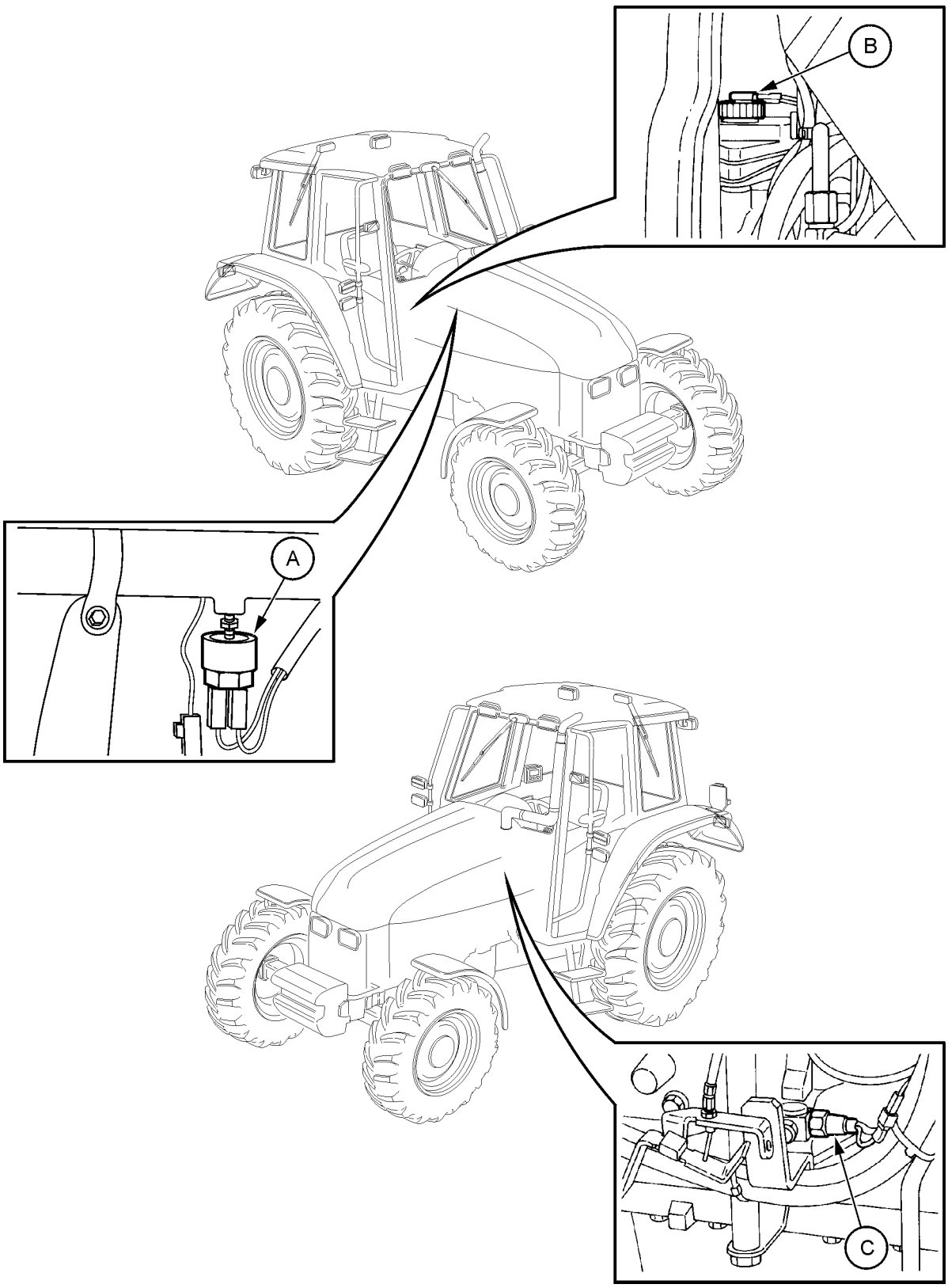
Engine coolant temperature gauge (Fig. 5)

- Green area = normal temperature.
- White area = temperature too low.
- Red area = engine overheating.



5

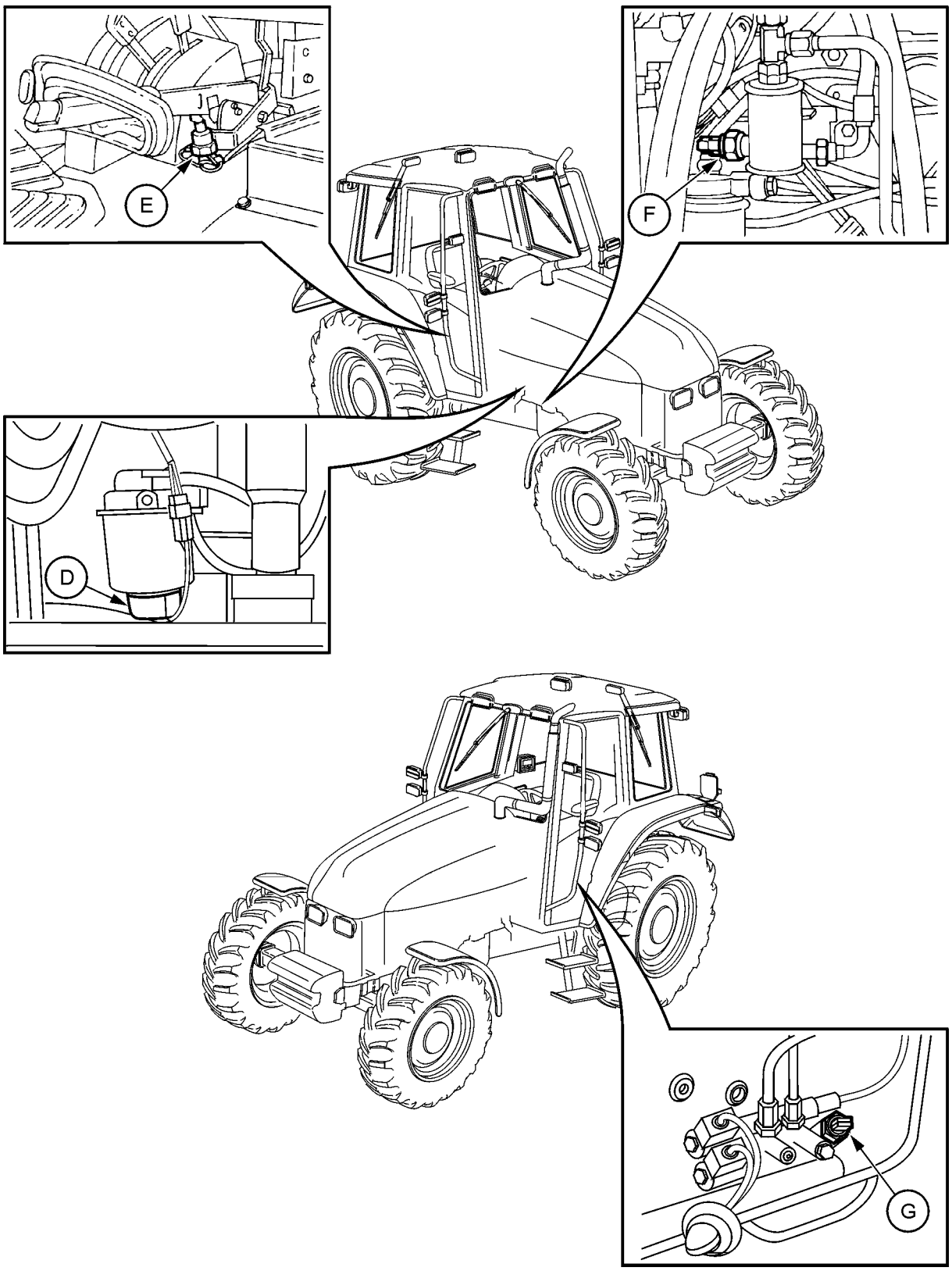
TRANSMITTERS, SENSORS AND SWITCHES



MPD3091A

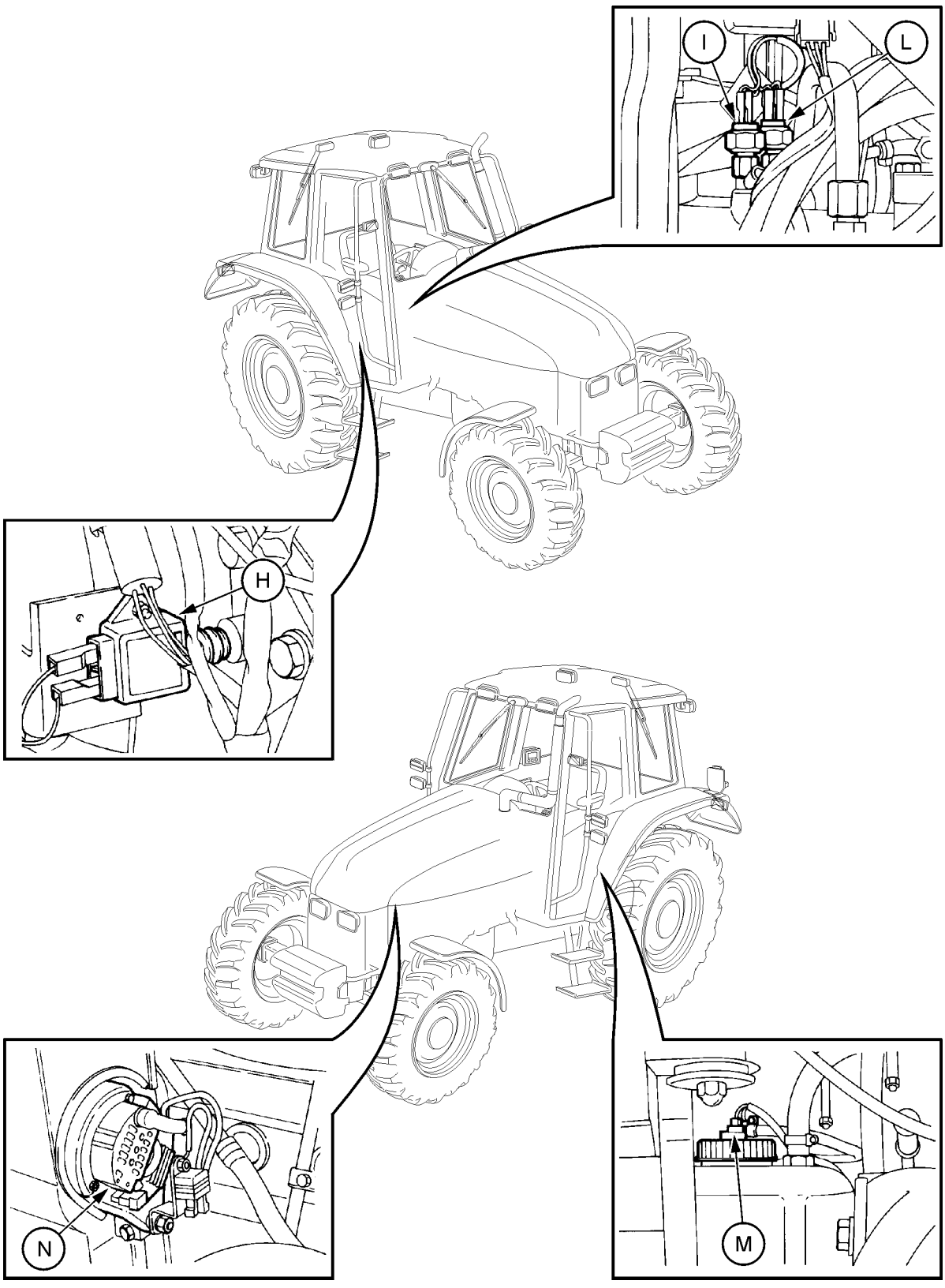
6

TRANSMITTERS, SENSORS AND SWITCHES



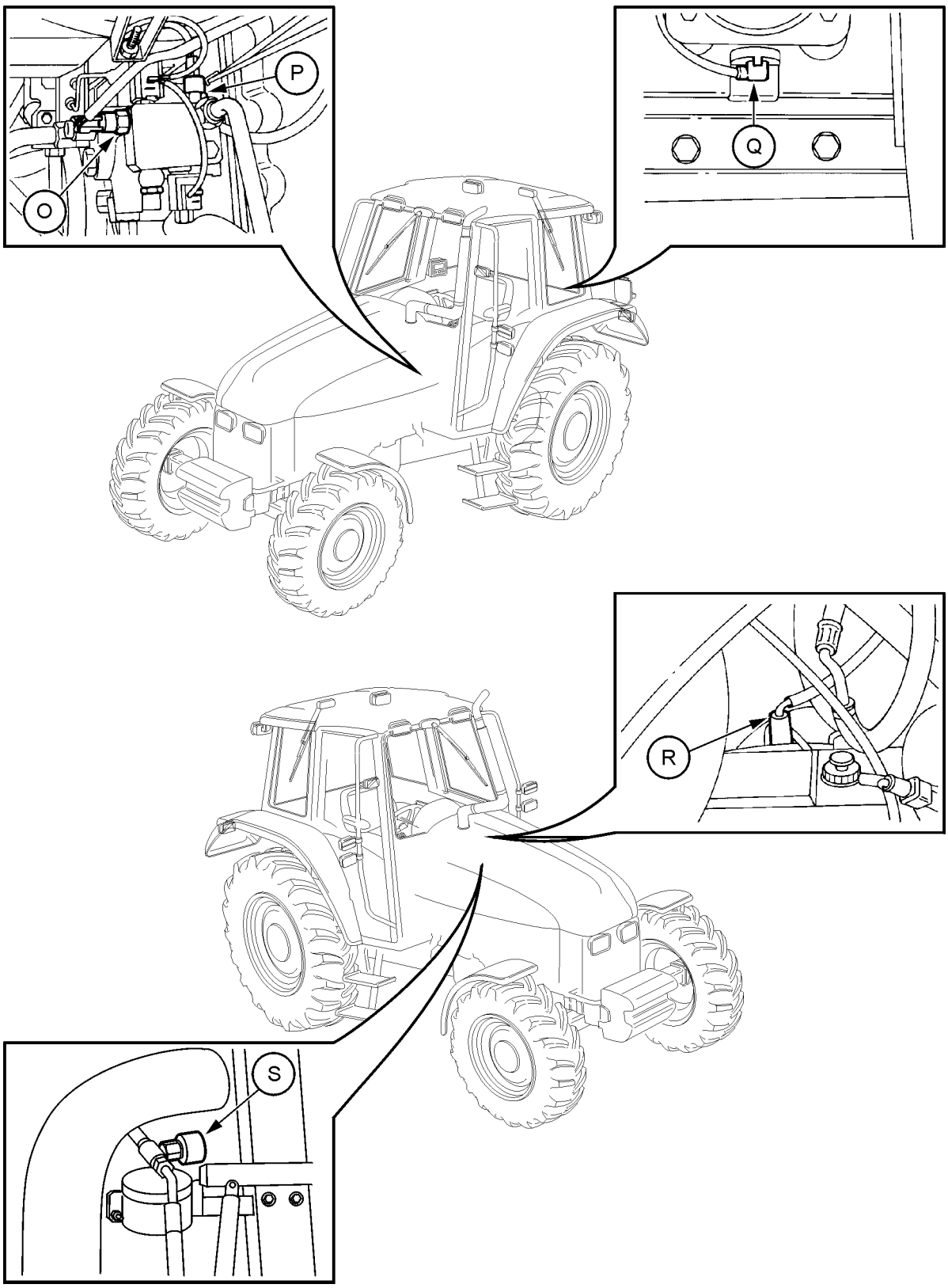
MPD3092A

TRANSMITTERS, SENSORS AND SWITCHES



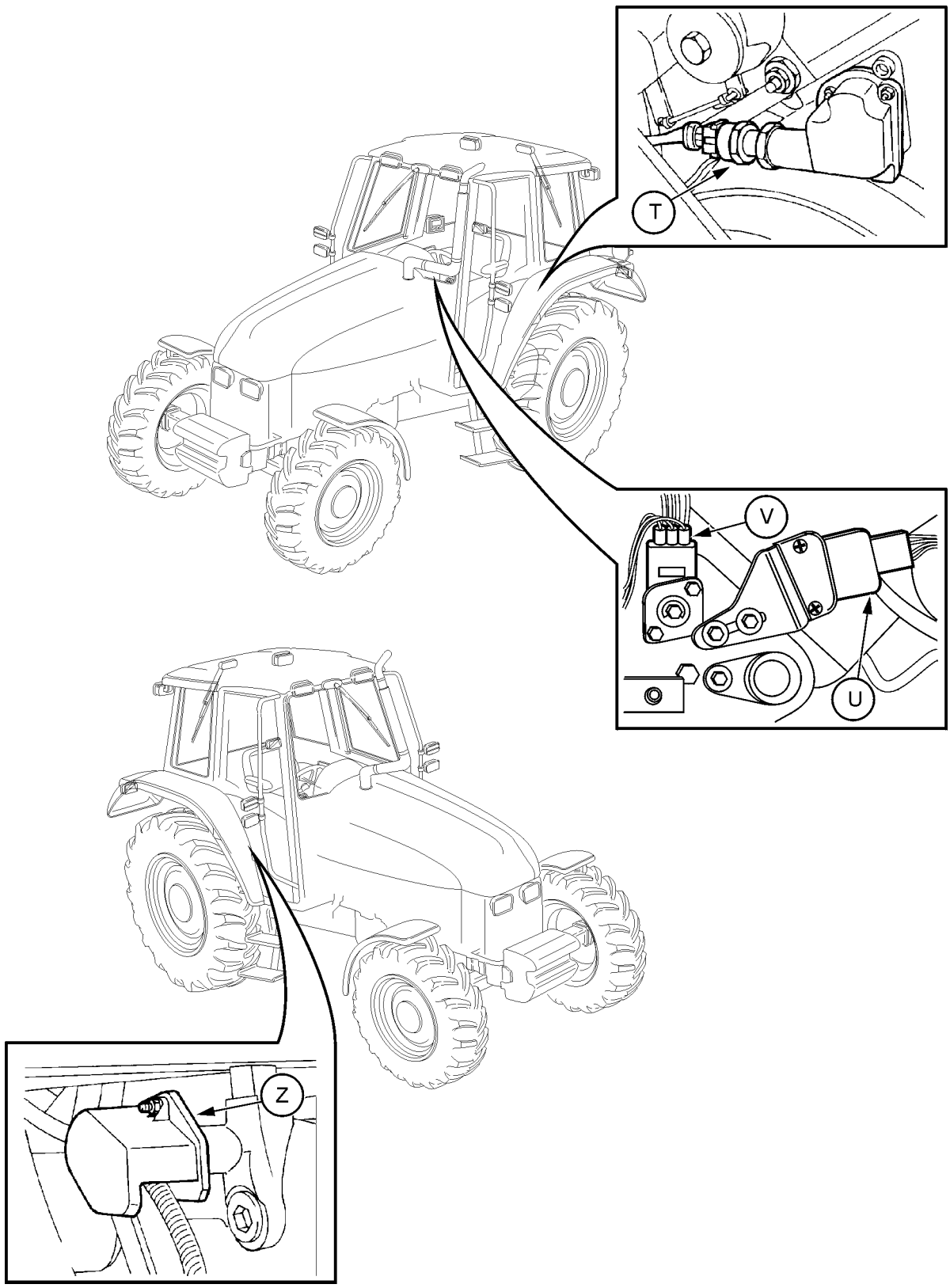
MPD3093A

TRANSMITTERS, SENSORS AND SWITCHES



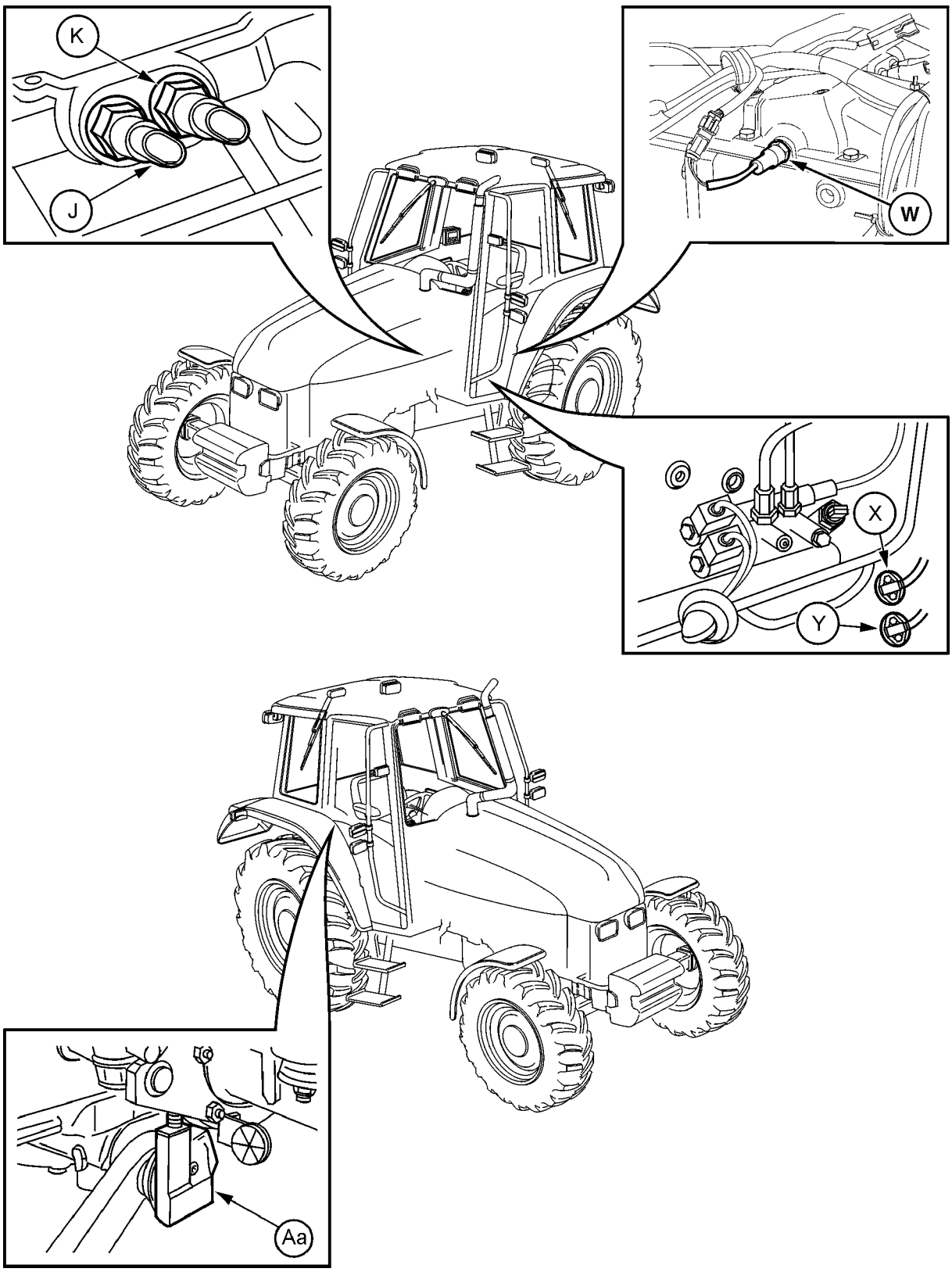
MPD3094A

TRANSMITTERS, SENSORS AND SWITCHES



MPD3096A

TRANSMITTERS, SENSORS AND SWITCHES



MPD3097A

11

TRANSMITTERS, SENSORS AND SWITCHES

A. AIR FILTER CLOGGED SENSOR
Activates when the vacuum in the air system exceeds a pre-stabilised value. The warning lamp lights up.

B. BRAKE OIL LEVEL SWITCH
Activates when the brake fluid drops below the minimum level. The warning lamp lights up.

C. ENGINE OIL PRESSURE SWITCH 9.86 psi (0.68 bar). The warning lamp lights up. Switch normally on.

D. WATER SEDIMENT IN FUEL SENSOR
Activates when water comes into contact with the sensor. The warning lamp lights up.

E. PARKING BRAKE SWITCH
The switch closes when the parking brake is applied.

F. GEAR OIL PRESSURE SWITCH
Activates when the gear oil pressure drops below 159.54 psi (11 bar). The warning lamp lights up. Switch normally on.

G. 4WD WARNING LAMP SWITCH
Activates when there is no oil pressure in the 4WD control lines. The warning lamp lights up. Switch normally on.

H. DIFFERENTIAL LOCK INDICATOR SWITCH
Activates when the differential lock is engaged. The warning lamp lights up. Switch normally off.

I-L. BRAKE LIGHTS SWITCHES
Activates when the brakes are applied.

M. FUEL LEVEL TRANSMITTER
The transmitter potentiometer provides a signal that determines the level in the fuel tank.

N. ALTERNATOR
Provides a square wave signal and recharges the battery. The alternator also provides power for the electrical devices on the tractor.

O. TRAILER BRAKE OIL PRESSURE SWITCH
Activates when the trailer brakes are applied. The warning lamp lights up.

P. TRAILER BRAKE SAFETY PRESSURE SWITCH
Activates when the trailer brake pressure circuit drops below 43.51 psi (3 bar). The warning lamp lights up.

Q. PTO SPEED SENSOR
The sensor output is modulated as instrument signal tension to display the PTO rotation speed on the speedometer-tachometer.

R. ENGINE COOLANT TEMPERATURE TRANSMITTER
The temperature transmitter resistance changes in proportion to the coolant temperature, generating a modulated tension signal that is transmitted to the instrument.

S. CONDITIONER FILTER/DRYER SENSOR
Shows the quantity of impurities inside the filter.

T. ELECTRONIC LIFT LH DRAFT SENSOR
Indicates the drawbar pull to the lift, on the left-hand side.

U. CLUTCH PEDAL SWITCH
Activates when the clutch pedal is pressed and sends an ON-OFF signal to the Power Shuttle control unit.

V. CLUTCH PEDAL SENSOR
Shows the clutch pedal position with a resistance variation and sends a variable signal to the Power Shuttle control unit.

Z. LIFT ARM POSITION SENSOR
Reads the position of the lift arms.

J. R2 RANGE LEVER POSITION SENSOR
Reads the position of the range unit.

K. R1 RANGE LEVER POSITION SENSOR
Reads the position of the range unit.

W. GEAR LEVER POSITION SENSOR
Reads the gear position when in the neutral position.

X. ELECTRONIC LIFT SPEED SENSOR
Reads the theoretical forward drive speed of the tractor.

Y. POWER SHUTTLE CONTROL UNIT SPEED SENSOR
Sends a speed signal to the Power Shuttle control unit.

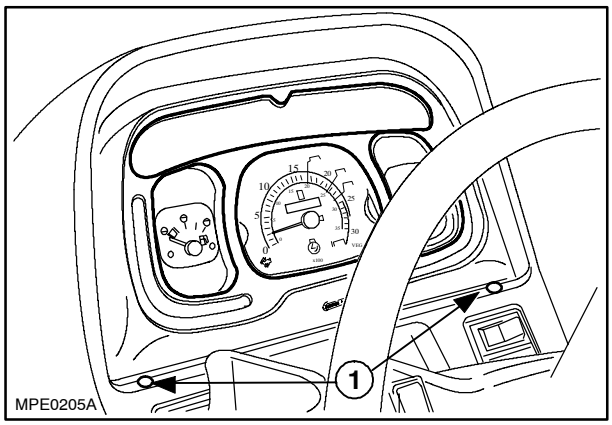
Aa. ELECTRONIC LIFT RH DRAFT SENSOR
Indicates the drawbar pull to the lift, on the right-hand side.

MAINTENANCE

REPLACING THE MULTI-PURPOSE WARNING LIGHTS ON THE INSTRUMENT PANEL

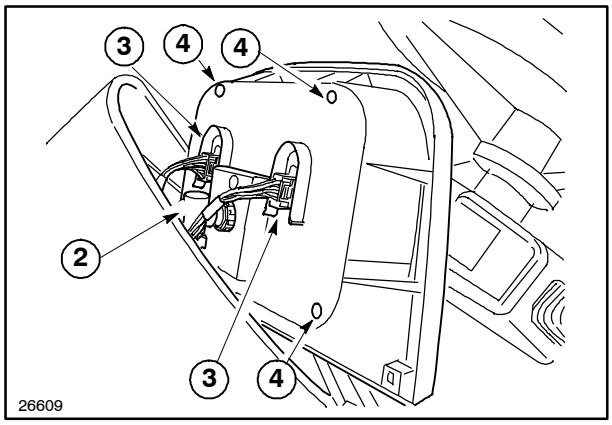
Replace indicator lights as follows:

1. Unscrew the two screws (1) that secure the instrument (fig. 12).
2. Remove the instrument panel from its seat and disconnect the rev counter terminal (2) (fig. 13).
3. Disconnect the connections (3) and remove the instrument (fig. 13).



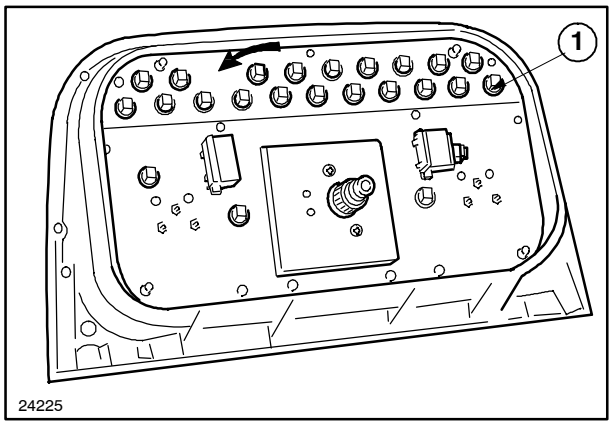
12

4. Unscrew the screws (4) securing the cover (fig. 13) and remove.



13

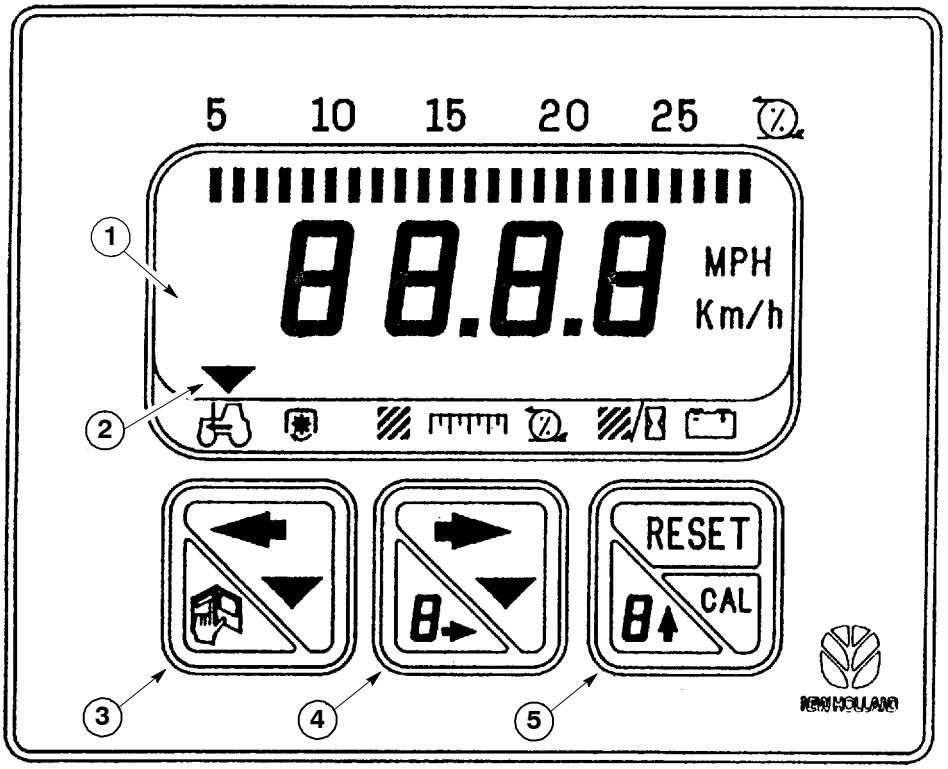
5. Turn the faulty indicator (1, fig. 14) anticlockwise for 1/4 turn, extract and replace with an identical indicator (12 V - 2 W) (12 V - 3 W for alternator recharge).



14

ELECTRONIC INSTRUMENT PANEL

INTRODUCTION



15

The electronic instrument (E.I.M.) (fig. 15), supplied on demand, comprises:

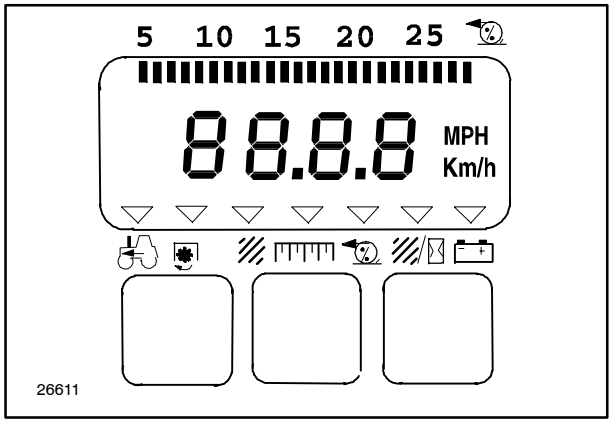
1. LCD function display
2. Function selection pointer
3. Main left-hand push-button (main menu search)
4. Main right-hand push-button (moves function pointer to the right)
5. Function reset push-button (“total area worked” and “distance in km covered with equipment down”), instrument calibration, data increase.

LCD
FUNCTION DISPLAY (Fig. 16)

According to the selections made, the display shows the following functions:

- Self-diagnosis (carried out automatically when the key is turned to the first position)
- Units of measurement:

  EU = European system
  USA = English-speaking system
  (providing information on: tractor speed, total area worked, distance travelled)
- Tractor speed (in km/h or MPH)
- CAL (calibration)
- NORD (NO RADAR): indicates correct calibration operation
- Implement width (to calculate the area effectively worked)
- PTO speed
- Total area worked (in hectares or acres)
- Distance covered (in km or in miles)
- Total area worked in one hour (in hectares or acres)
- Battery charge status (in V).

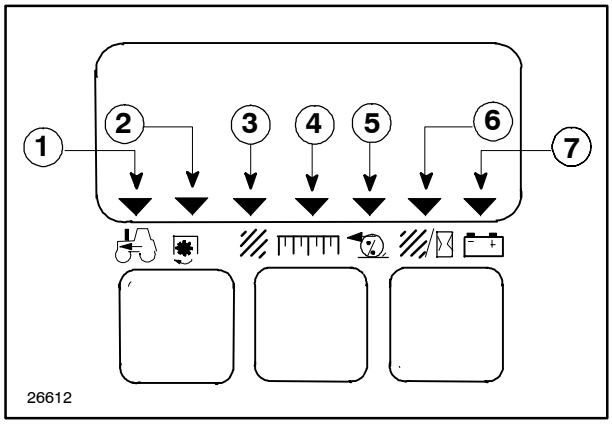


16

FUNCTION SELECTION INDEX (Fig. 17)

By moving the selection index, with push-buttons (see figs. 18 and 16), depending on the position selected, the following indications are displayed:

1. Tractor forward drive speed, manual calibration, access to implement width setting operative system.
2. PTO speed
3. Total area worked
4. Implement width, distance covered
5. Function not used
6. Total area worked in one hour
7. Battery charge status



17

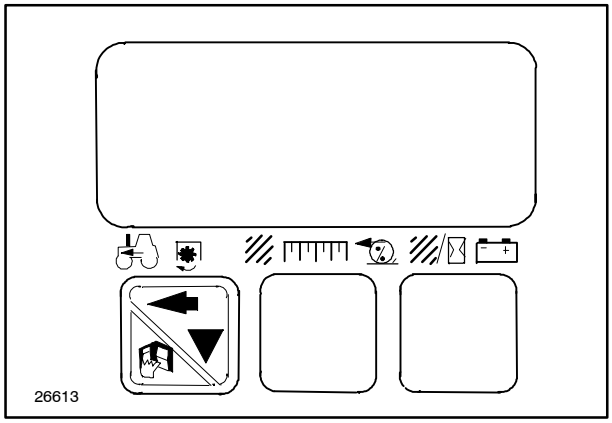
MAIN LH PUSH-BUTTON (Fig. 18)

A) If pressed once:

- functions selection (moves the function selection pointer to the left)
- calibrating the instrument

B) If pressed (and held) for more than three seconds:

- main menu search
- data storage of implement width and instrument calibration

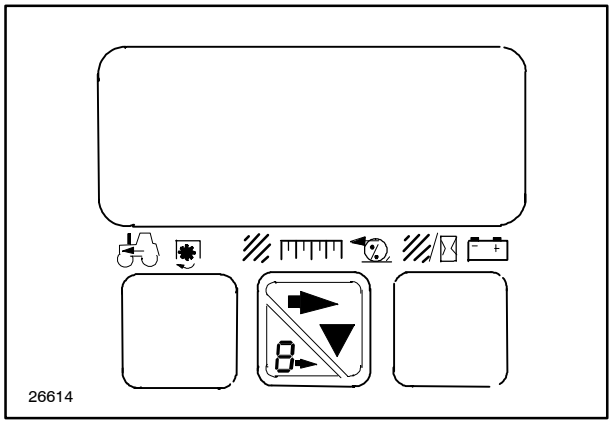


18

CENTRAL MAIN PUSH-BUTTON (Fig. 19)

If pressed once:

- Function selection (moves the function selection pointer to the right).
- Selection of the last three figures to be modified (shown on display) in the “implement width setting” function.



19

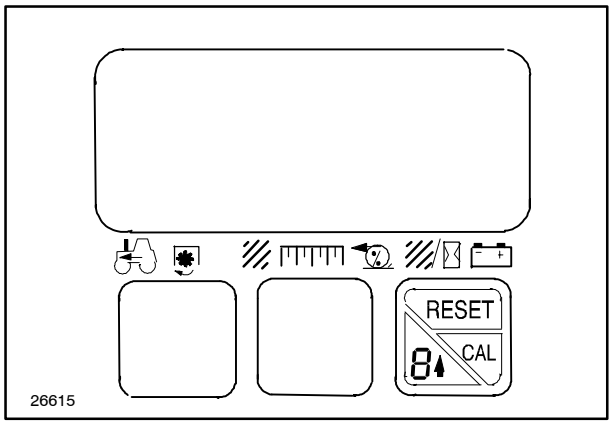
MAIN RH PUSH-BUTTON (resetting functions) (Fig. 20)

A) If pressed once:

- measuring unit change (European / English-speaking) (RESET message).
- instrument calibration, modification of each individual flashing figure (on the display) in the “implement width setting” function (CAL message).

B) If pressed (and held) for more than three seconds:

- zero-sets “total area worked” and “distance covered with implement lowered” functions data (RESET message).



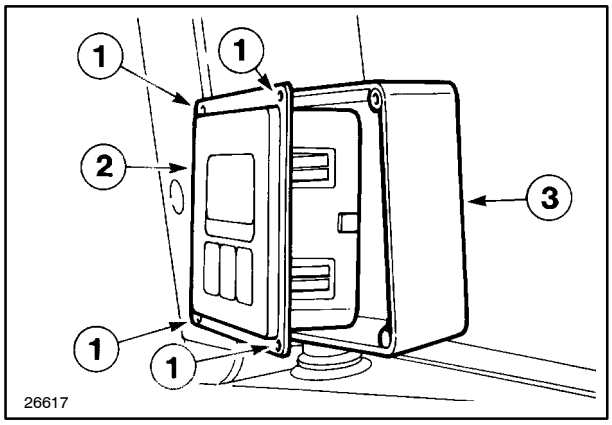
20

MAINTENANCE

ELECTRONIC INSTRUMENT REPLACEMENT

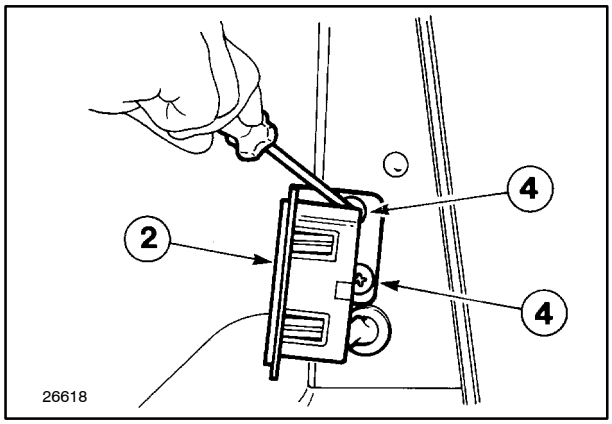
To replace the electronic instrument, proceed as follows:

1. Unscrew the four screws (1) that secure the instrument (2) to the rear guard (3), then extract the guard (fig. 21).



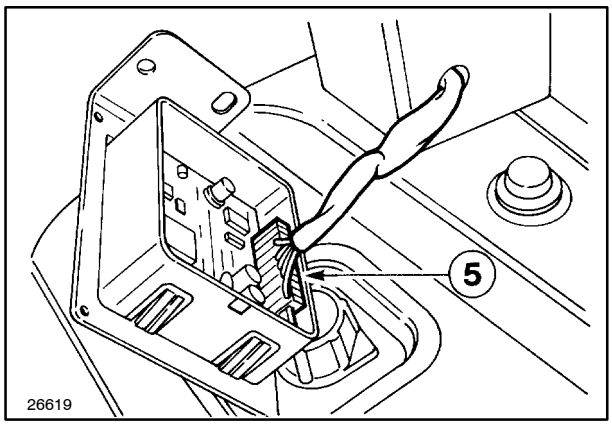
21

2. Move the instrument (2) slightly forwards to access the two screws (4) retaining the instrument support flange, and unscrew (fig. 22).



22

3. Move the instrument in order to be able to disconnect the connector (5), then remove the instrument (fig. 23).



23

DIAGNOSTICS

CAUTION

Notes to help the operator make diagnosis and troubleshooting easier.

1. The measurements taken to read:
   voltage;
   resistance;
   frequency;
   must be carried out with a digital tester.

NOTE: *The resistance values shown are valid for a temperature of 68 °F (20 °C) (ambient temperature). With higher or lower tractor temperatures, the relative resistance values shown in the manual should vary accordingly.*

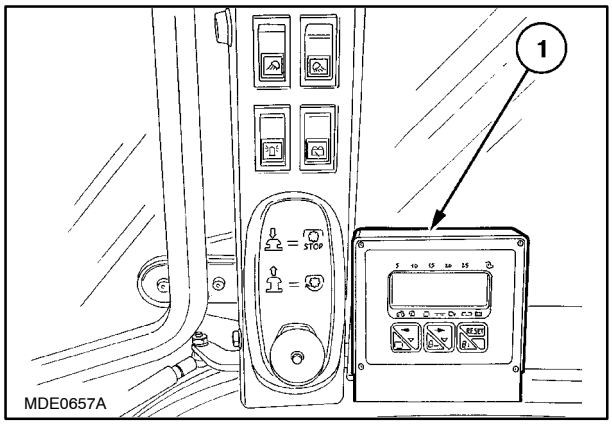
2. The "short to ground" message refers to a resistance value of less than 5 Ohm (Ω).

3. When a fault occurs, before carrying out any kind of service operations, check that the specific connections (digital instrument, sensors, switches, etc.) are correctly connected.
   A faulty connection could be the cause of incorrect tractor operation.

4. The connection references indicate: the wire dimension and colour, and the connection pin number.
   Example: 0.5 S (31)
   0.5 = wire dimension;
   S = wire colour;
   (31) = connection pin number.

LOCATION OF THE DIGITAL INSTRUMENT

The digital instrument (1) is located next to the RH upright.



24

DIGITAL INSTRUMENT

The digital instrument display is not powered-up or the night lighting is not working.

Turn the starter key to the OFF position. Check fuses F20 and F4, Section 55, Chapter 6, pages 8 to 12), have they blown?

NO

YES

Replace the blown fuse or fuses.

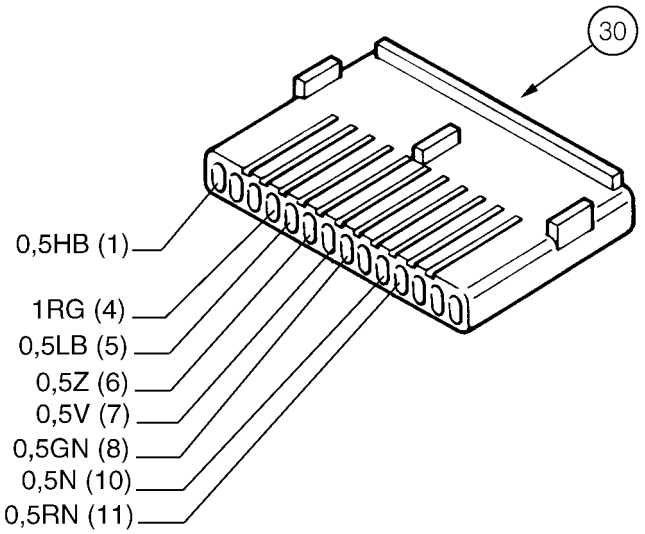
Detach the digital instrument and disconnect the relative connection (30). Measure the voltage between pin 10 (N) and pin 11 (RN) on connection (30). Is the reading 12V?

NO

YES

Replace the digital instrument.

Check the wiring and eliminate the cause of the open circuit.



DIGITAL INSTRUMENT

The tractor speed is not shown on the digital instrument display.

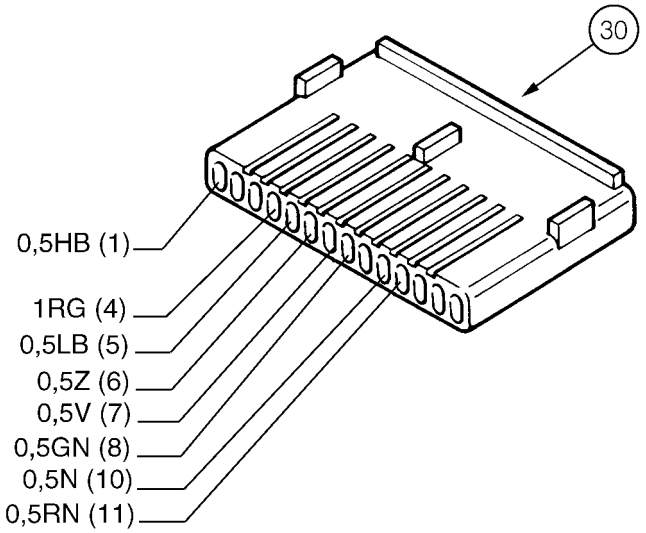
Turn the starter key to the OFF position.
Detach the digital instrument and disconnect the relative connection (30).
Between pin 1 (HB) on connection (30) and ground, is the reading ~ 500 Ω?

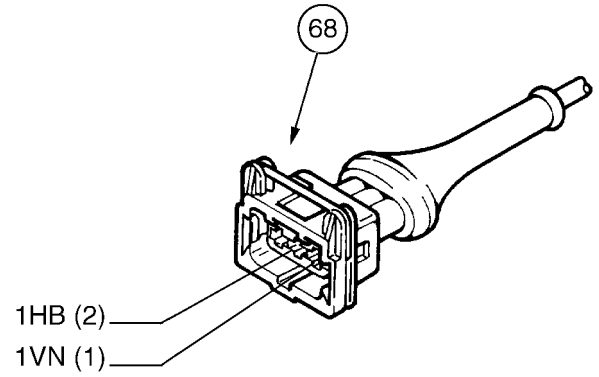
NO → Is there electrical continuity on wire (HB) between pin 1 on connection (30) of the digital instrument and pin 2 on connection (68) of the advance speed sensor?

NO → Check the wiring and eliminate the cause of the open circuit.
Does the fault persist?

YES → Replace the speed sensor.

YES → Replace the digital instrument.





DIGITAL INSTRUMENT

The digital instrument display does not show the PTO rotation speed.

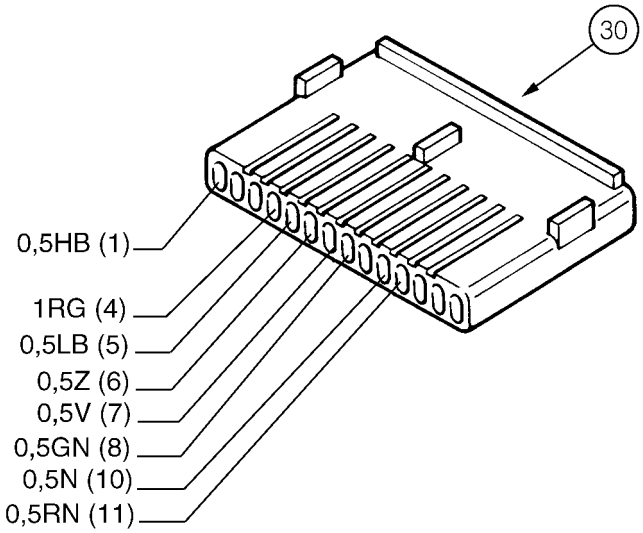
Turn the starter key to the OFF position.
Detach the digital instrument and disconnect the relative connection (30).
Between pin 4 (RG) on connection (30) and ground, is the reading ~ 700 Ω?

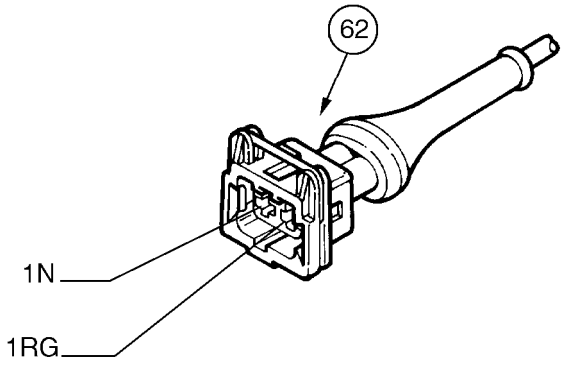
NO → Is there electrical continuity on wire (RG) between pin 4 on connection (30) of the digital instrument and connection (62) on the PTO rotation speed sensor?

NO → Check the wiring and eliminate the cause of the open circuit.
Does the fault persist?

YES → Replace the rotation speed sensor.

YES → Replace the digital instrument.





DIGITAL INSTRUMENT

The ”hectares worked” function on the digital instrument display is not active.

Turn the starter key to the OFF position. Detach the digital instrument and disconnect the relative connection (30). With the lift arms fully lowered, between pin 6 (Z) on connection (30) and ground, is the reading 12V?

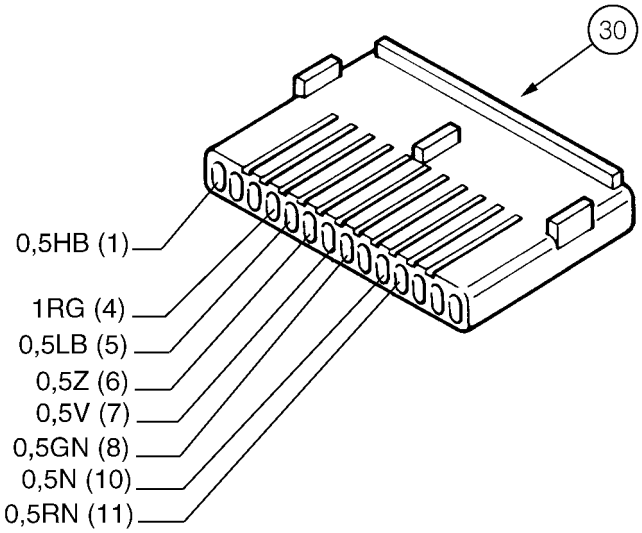
NO → Is there electrical continuity on wire (Z) between pin 6 on connection (30) of the digital instrument and lift status connection (127)?

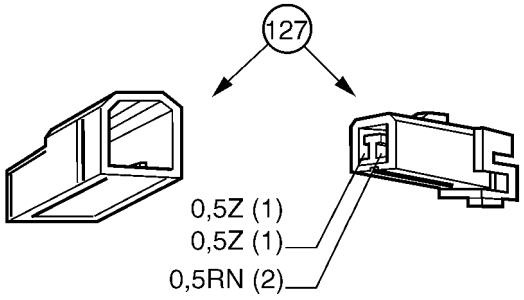
NO → Check the wiring and eliminate the cause of the open circuit.

YES → Replace the lift status switch.

YES → Replace the digital instrument.

Note - With the electronically controlled lift, the lift status signal comes directly from pin 16 on the electronic control unit.





DIGITAL INSTRUMENT

With the radar fitted, the display does not show slipping or speed.

If the electronic lift control panel indicates fault 41, proceed as follows to resolve the problem.

Turn the starter key to the OFF position. Detach the digital instrument and disconnect the relative connection (30). Between pin 5 (LB) on connection (30) and ground, is the reading 12V?

NO

Is there electrical continuity on wire (LB) between pin 5 on connection (30) and pin 4 on the radar connection (123)?

NO

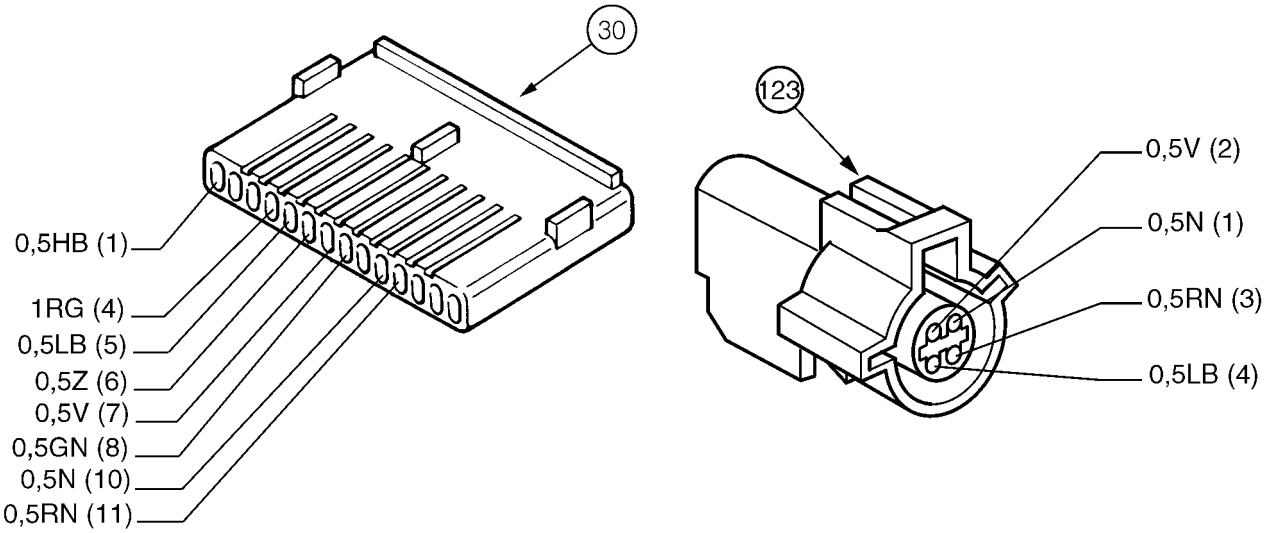
Check the wiring and eliminate the cause of the open circuit.

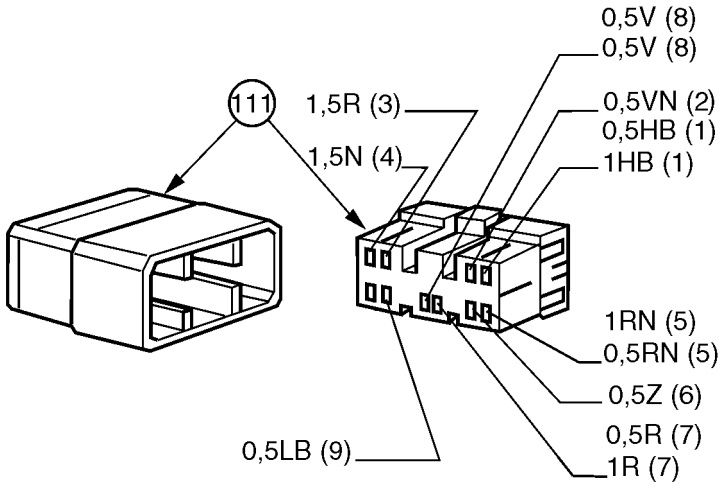
YES

Is there electrical continuity on wire (V) between pin 7 on connection (30) of the digital instrument and pin 8 on electronic lift connection (111)?

YES

Replace the digital instrument.





SECTION 55 - ELECTRICAL SYSTEM

Chapter 2 - COMPONENTS
(version from frame no. 1266941 for models with cab, from frame no. 1268756 for models with platform)

CONTENTS

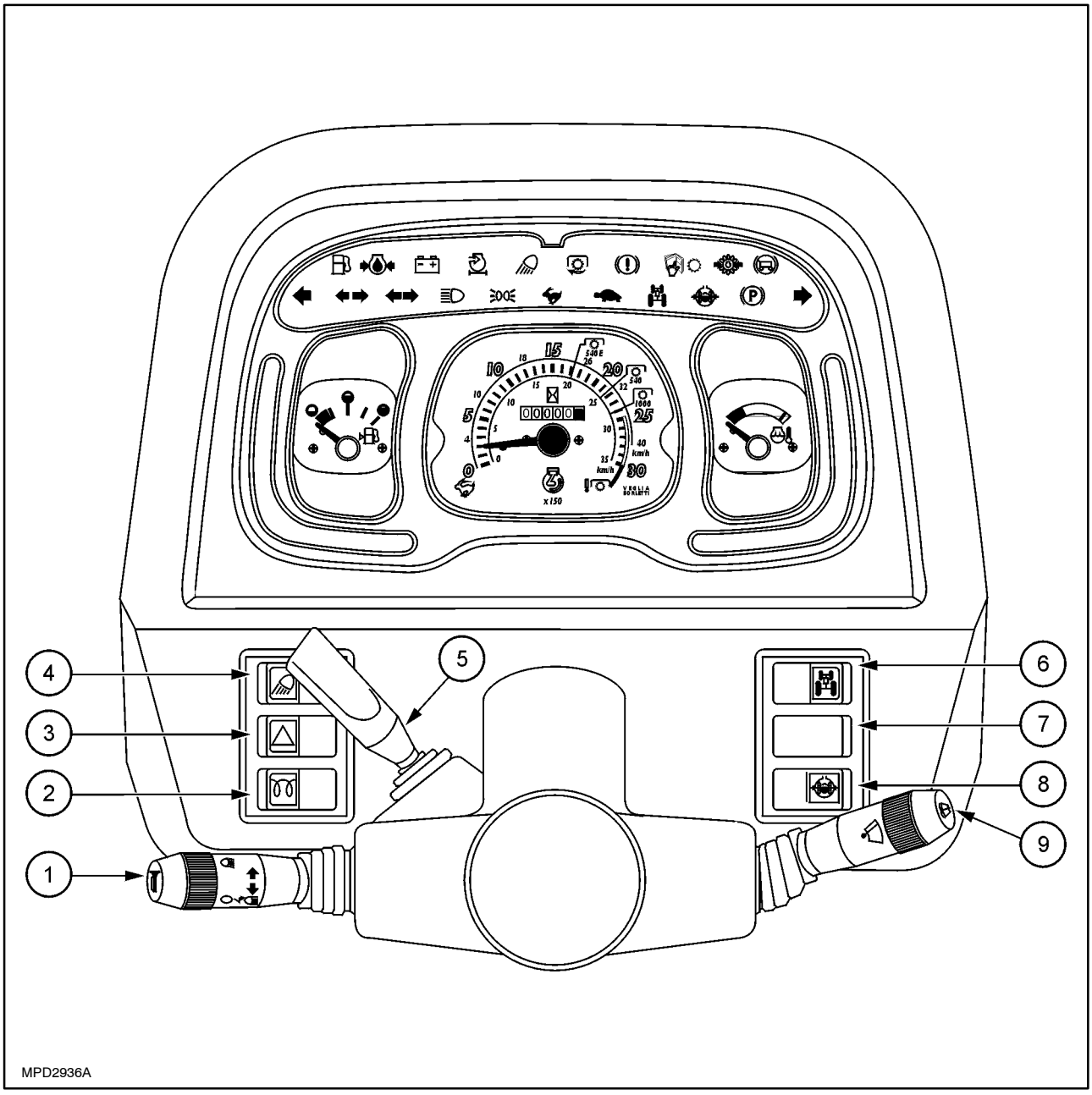
Section	Description	Page
55 40440	Introduction	1
	Dashboard controls	2
	Operating controls, right-hand side	7
	Electronic lift control panel	9
	Controls on right-hand cab upright	10
	Cab controls	12
	External controls	14
	Maintenance	15

INTRODUCTION

The components described in this section are grouped in control-types, as described below:

1. Dashboard controls.
2. Operating controls, right-hand side.
3. Cab controls.
4. External controls.

DESCRIPTION OF COMPONENTS



1

DASHBOARD CONTROLS

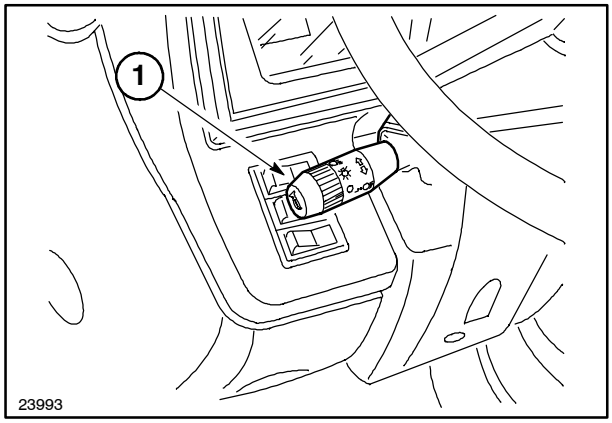
The dashboard controls are as follows:

1. Light control lever with direction indicators and horn incorporated.
2. Thermostart or Start-Pilot control switch.
3. Flashing hazard warning lights control switch.
4. Work lights switch (models with cab only).
5. Power Shuttle control lever.
6. 4WD control switch.
7. Not used.
8. Differential lock switch.
9. Windscreen washer/wiper control lever.

Lights control lever (Fig. 2).

The lights/horn switch (1) controls, the turn indicators, the headlight full beam flasher, switching from dipped to full beam front headlights.

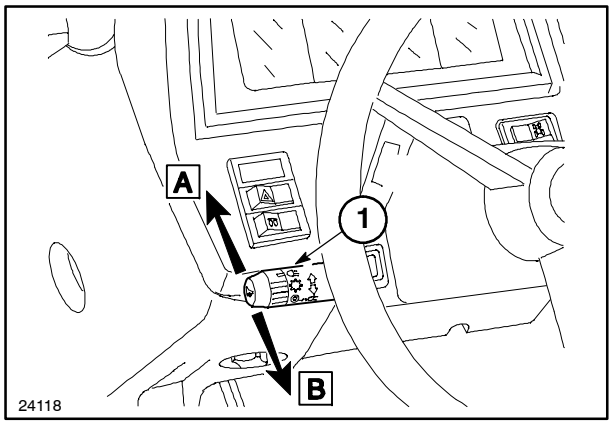
The external lights will only work with the key switch in position B (see fig. 15).



2

Direction indicator lights (Fig. 3)

Moving the lever to positions A and B, indicates the intention to turn to the right (A) or to the left (B). The turn signal indicator lights on the instrument panel will also flash when the turn signals are actuated.



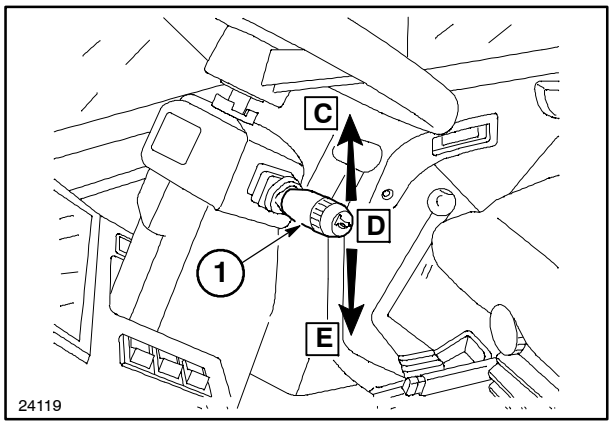
3

Tail/side lights, full beam, dipped beam circuit and front headlight flash (fig. 4 and 5).

By moving the lever (1) to positions C, D, E, and turning the mark (1) on the knob (2) to symbols (3) or (4) the different functions are activated.

The lights selection knob (2) functions with the starter switch (see fig. 15) to position B.

The side lights can also be switched with the starter switch (see fig. 15) in position P.

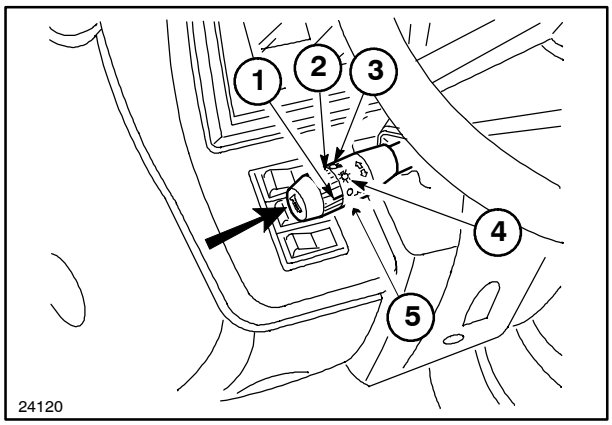


4

All the lights are switched OFF by turning the mark (1) on knob (2) to symbol (5).
In this position, only the direction indicators and horn remain operative.

Horn

To sound the horn, press the end of the knob 2 (Fig. 5) in the direction indicated by the arrow.



5

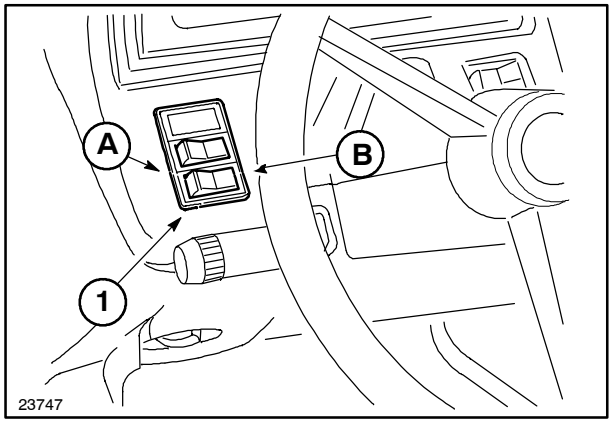
Thermostart or Start-Pilot control switch (Fig. 6)

This switch is used to start the engine in when the external temperature is low, both in the THERMOSTART or Start-Pilot functions, and is linked to the position of the starter key (Fig. 15).

The switch has two settings:

- position A: to switch on, momentarily, with automatic return when released.
- position B: fixed (OFF).

In both cases, the switch must be pressed and held in position A until the engine starts then, when released, it will return automatically to position B.

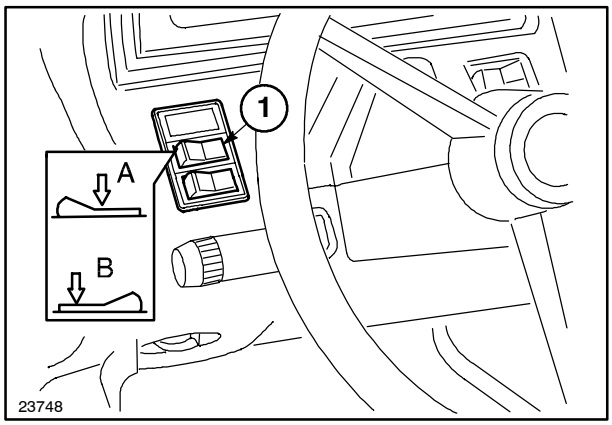


6

Flashing hazard warning lights switch (Fig. 7)

The hazard lights are activated by pressing the red part (position B) of switch (1).

The switch will flash together with the direction indicators.

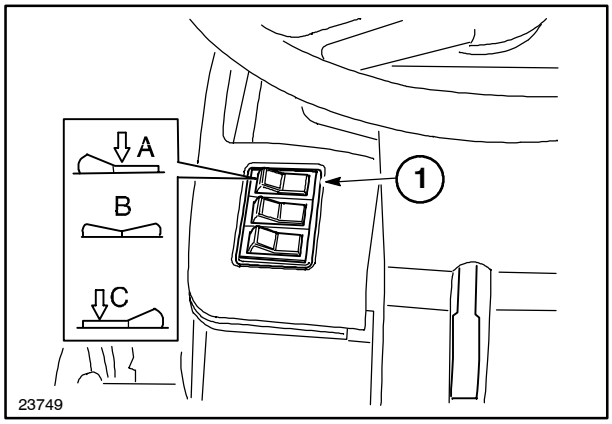


7

Work lights switch (models with cab only) (Fig. 8)

The switch (1) has three fixed positions:

- position A = lights OFF;
- position B = rear lamps on;
- position C = front and rear lamps on.

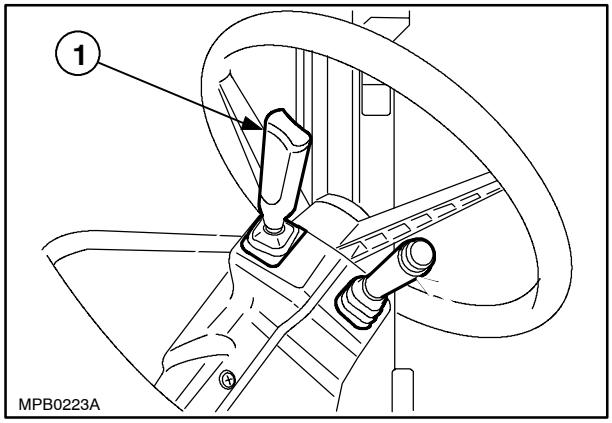


8

Power Shuttle control lever (Fig. 9)

The Power Shuttle lever (1) inverts the direction of travel and has three settings:

- central position: neutral
- forward position: forward drive
- backward position: reverse



9

4WD control switch (Fig. 10)

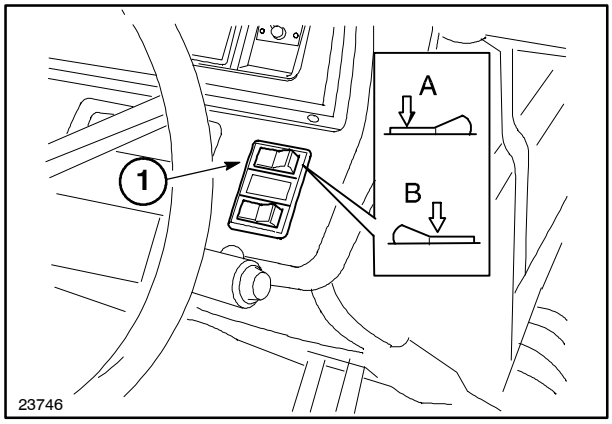
Front-wheel drive can increase the tractor's grip on the surface; the benefits of this are particularly noticeable when working on uneven, muddy or slippery ground, on ploughed ground or in difficult conditions. Front drive engagement is electrohydraulic and can be automatic or manual:

- Automatic

  With the switch (1) pressed to position A and the brake pedals pressed: 4WD is disengaged when the pedals are released.

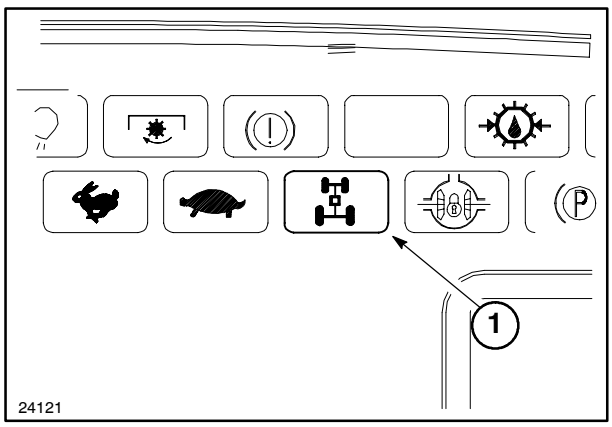
- Manual

  With the switch (1) pressed to position B, 4WD is permanently engaged. To disengage, press the switch (1) to position A.



10

In both cases, engagement is indicated by the illumination of warning light (1) (Fig. 11).



11

Differential lock control switch (Fig. 12)

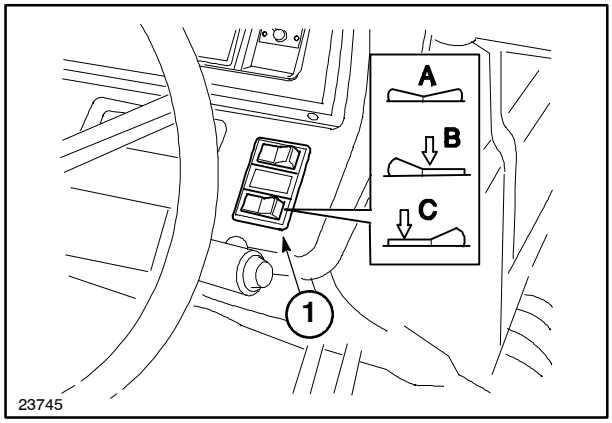
The differential lock is electrohydraulic, activated by push-button (1) and is fitted (as an optional) on 24.85 mph (40 km/h) 4WD models.
Use is recommended in the following situations:

- when ploughing, to prevent the wheel that is not in the furrow from slipping;
- when one of the drive wheels is on uneven, muddy or slippery ground and tends to slip.

The lock control switch has three settings (see fig. 12):

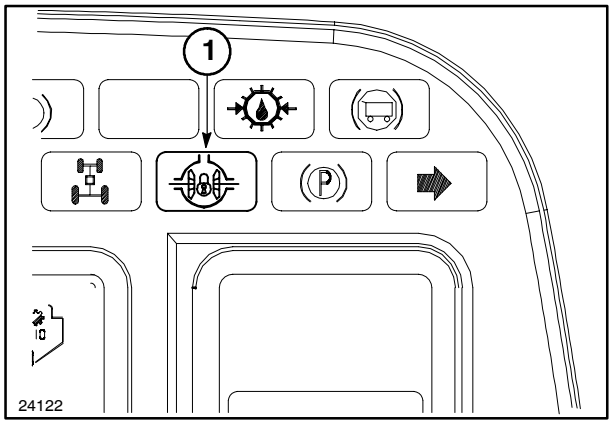
- position A = differential lock disengaged;
- position B = differential lock ON: to disengage the differential lock, press the brake pedals; it re-engages automatically when the pedal is released;
- position C = differential lock engaged: functions automatically by means of the Lift-O-Matic and brake pedals.

to release the differential, reduce tractor speed and press switch (1) to position A.



12

Differential lock engagement will be signalled by the illumination of an indicator on the dashboard (1) (Fig. 13).



13

Front windscreen washer/wiper control lever (Fig. 14)

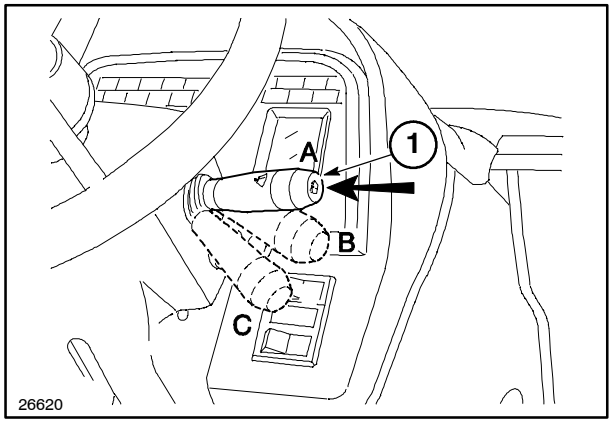
Operates with the starter switch in position B (see fig. 15).

Lever (1) controls the front windscreen wiper and the windscreen washer.

The lever has three settings:

- Position A = off.
- Position B = standard speed.
- Position C = fast speed.

Press on the end of the lever as shown by the arrow to operate the windscreen washer.



14

Starter switch (Fig. 15)

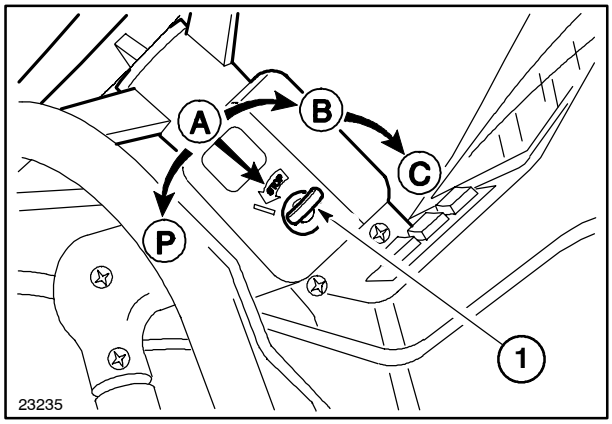
The starter switch (1) performs the following functions according to the position selected:

A. Engine stopped: automatic activation of fuel injection cut-off. Current not supplied to any circuit (key can be removed).

B. Stand-by for engine start up (with Thermostart or Start-Pilot), several users are powered-up; the indicators and instruments are operative.

C. Non-fixed position with return to position B when released: the engine can be started.

P. Parking lights ON, control panel illuminated, auxiliary lights switch powered-up: the key can be extracted.



15

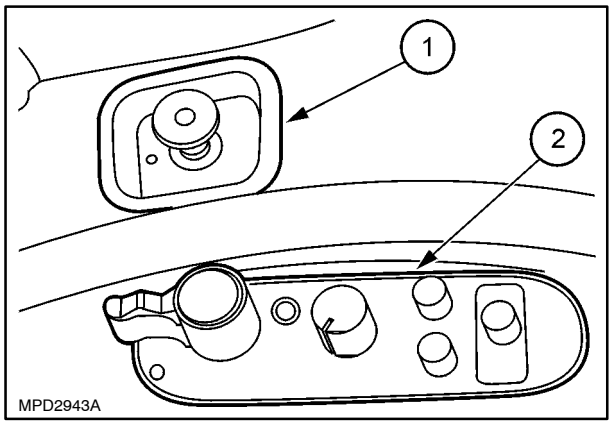
RIGHT-HAND SIDE OPERATING CONTROLS

They comprise the controls on the right-hand mudguard and those on the right-hand cab upright.

Right-hand mudguard (Fig. 16)

The following controls are located on the right-hand mudguard:

1. Electrohydraulic PTO control switch.
2. Electronic lift control panel (Version with electronic lift).



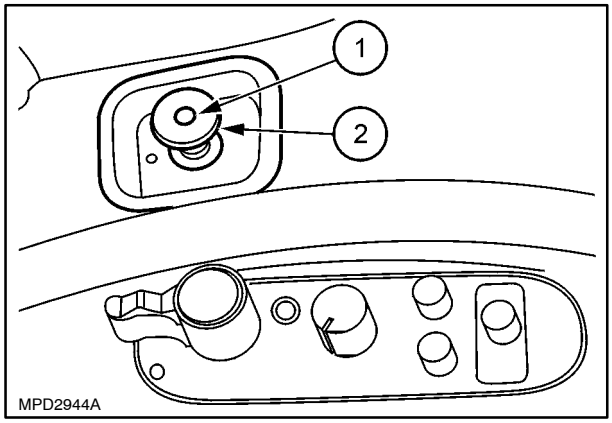
16

Electrohydraulic PTO control switch (Fig. 17)

The push-button (1) engages and disengages the Power take-off.

- ON = push-button pulled upwards;
- OFF = push-button pressed down.

To engage the power take-off, press push-button (1) and pull the knob (2) upwards. Engagement is controlled by an electromagnetic clutch. The indicator on the control panel comes on with a steady light to indicate that the PTO is engaged. To disengage the PTO, just press the knob downwards.



17

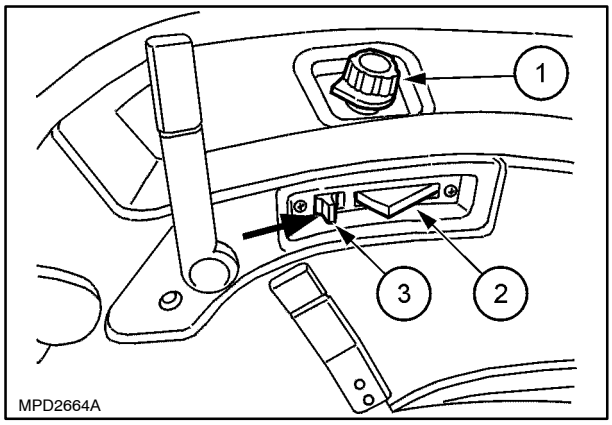
CONTROLS ON MUDGUARD (Fig. 18)
(version with hydraulic-mechanical lift)

LIFT-O-MATIC, control button for raising and lowering the lift arms.

1. Independent electrohydraulic PTO control knob (see page 9).
2. Rapid arm lowering push-button.
3. Rapid arm raising push-button.

To lower the implement, press the button (2) fully down.

To raise the implement, press button (3) backwards, as shown by the arrow in the drawing, in order to release button (2).
The lift arms will fully raise.

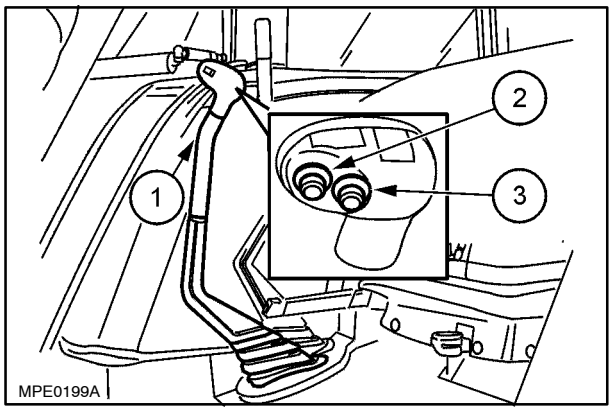


18

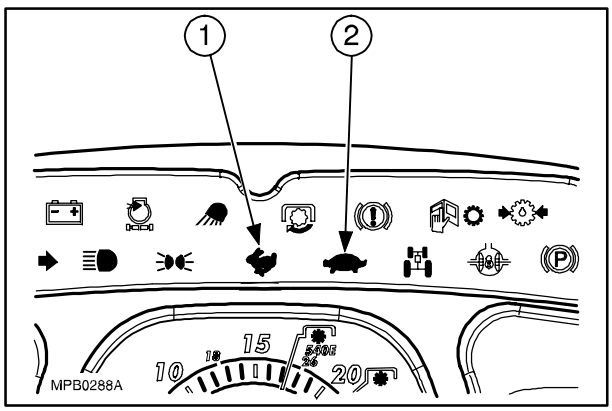
Gear lever with Dual Command (2 Speed Power Shift) push-buttons (Fig. 19)

The lever (1) is positioned on the right-hand side of the driving position and is fitted with the Dual Command (2 Speed Power Shift) control push-buttons, which are used to double the gears. It is therefore possible to switch from the HIGH to the LOW position, or vice versa, without using the clutch pedal.

- Push-button (2) = HIGH range selection; the warning light will illuminate (1, fig. 20).
- Push-button (3) = LOW range selection; the warning light will illuminate (2, fig. 20).

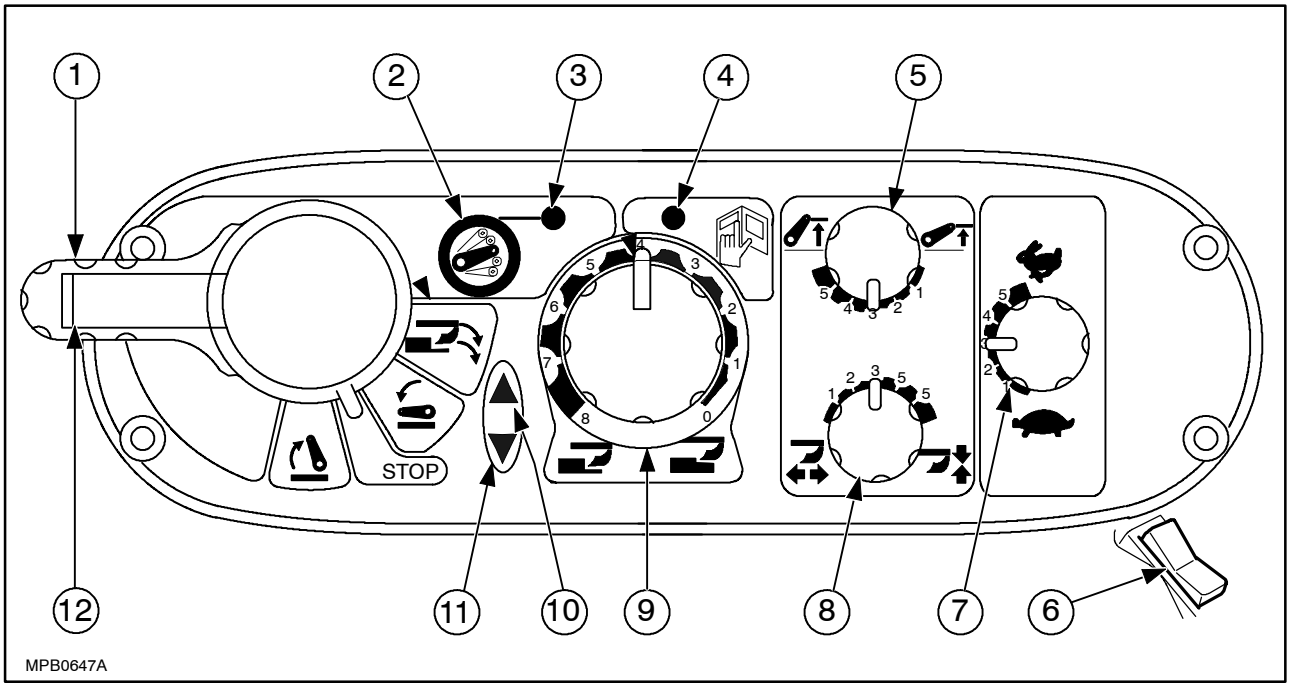


19



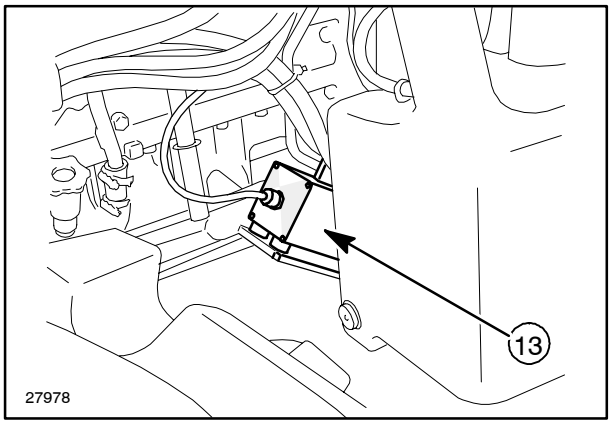
20

ELECTRONIC LIFT CONTROL PANEL (Fig. 21)



21

1. Raise and lower control lever (four settings).
2. Damping function ON push-button.
3. Damping function ON indicator.
4. Troubleshooting indicator.
5. Lift arms raise limit adjustment knob.
6. Automatic slip control switch (optional).
7. Lift arms descent speed adjustment knob.
8. Position/draft sensitivity adjustment knob.
9. Working depth adjustment knob.
10. Arms raised indicator.
11. Arms lowered indicator.
12. Lever (**1**) raised position lock push-button (STOP).
13. Radar (Fig. 22).



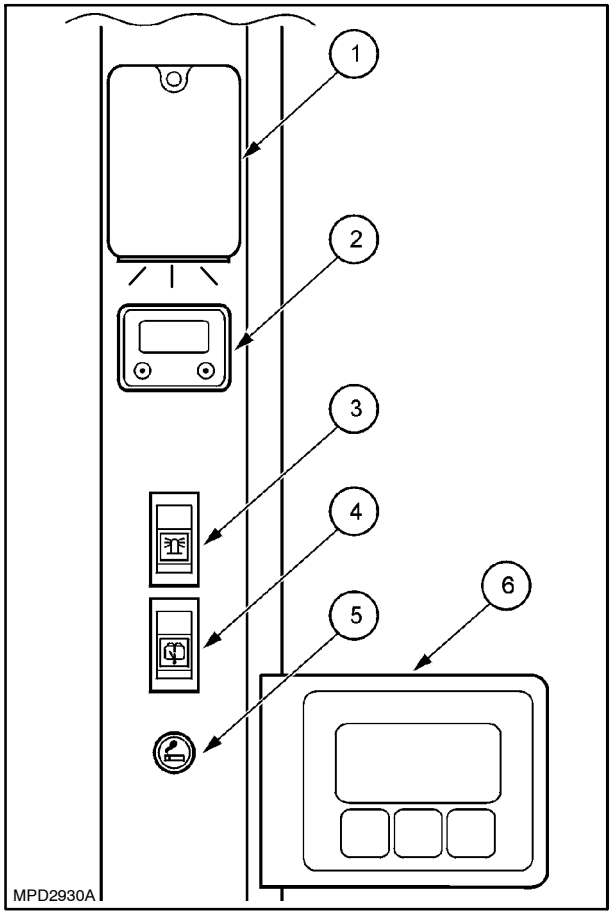
22

NOTE: *For a complete description of the lift system, refer to Section 35, chapter 6.*

CONTROLS ON RIGHT-HAND CAB UPRIGHT (Fig. 23)
(version prior to change valid until tractor no. 1228800)

The following controls and components are located on the right-hand cab upright:

1. Lighting;
2. Digital clock;
3. Rotating beacon ON-OFF switch;
4. Windscreen wiper/washer switch;
5. Cigar lighter;
6. Digital instrument (see chap. 1, page 13).



23

Lighting (1)

Illuminates the controls beneath and is controlled by the light control lever when the side lights are turned on.

Digital clock (2)

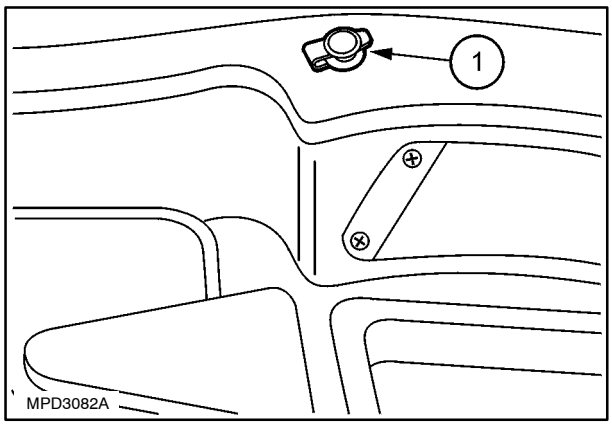
It is located under the lamp and is fitted with two push-buttons to set the hours and minutes.

Rotating beacon light ON/OFF switch (3)

The switch has two settings:

- push-button pressed = rotating beacon ON;
- push-button released = rotating beacon OFF.

To power-up the rotating beacon, connect to the socket (1) located under the cab roof, on the outside (Fig. 24).

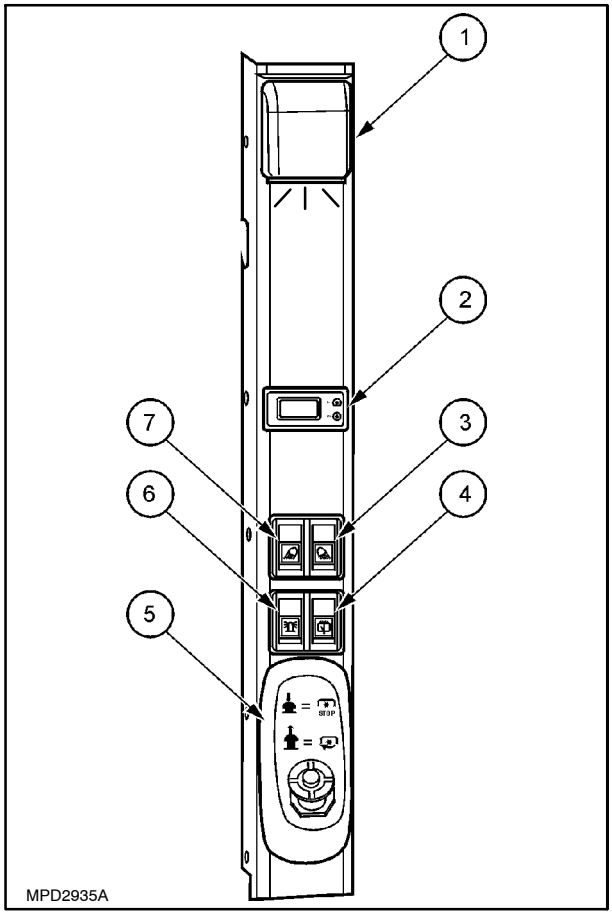


24

CONTROLS ON RIGHT-HAND CAB UPRIGHT (Fig. 25)
(version after change valid until tractor no. 1228801)

The following controls and components are located on the right-hand cab upright:

1. Lighting.
2. Digital clock.
3. Rear work lights control switch.
4. Windscreen wiper/washer switch.
5. Electrohydraulic PTO control switch.
6. Rotating beacon ON-OFF switch.
7. Front work lights control switch.



25

Controls lighting (1)

The controls lighting illuminates when the side/tail lights are switched on.

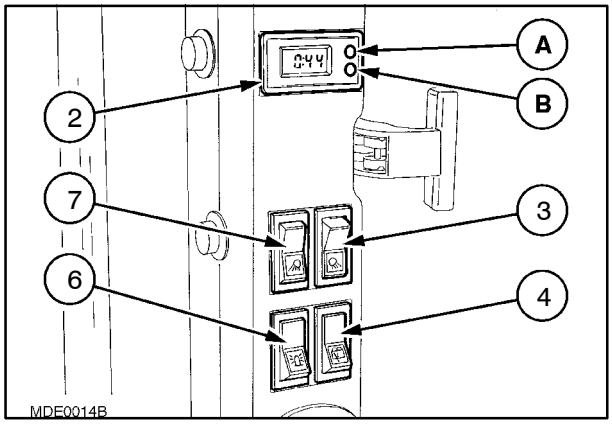
Digital clock (2, fig. 26)

Provided with a four-figure display for hours and minutes, with two lateral push-buttons for adjustment. Use a pointed instrument to set the hours (A) and minutes (B).

Rear work lights control switch (3, fig. 26)

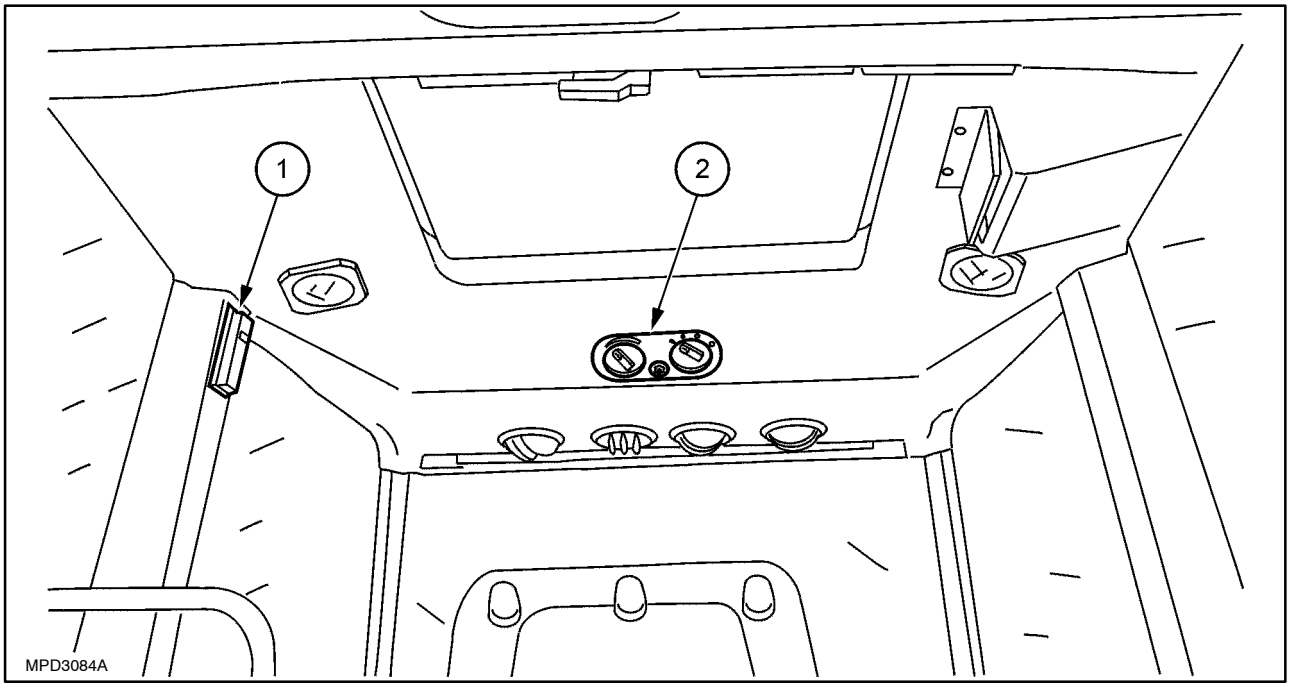
The switch has two settings:

- push-button pressed = rear lights ON;
- push-button released = rear lights OFF.



26

AIR CONDITIONED CAB CONTROLS



27

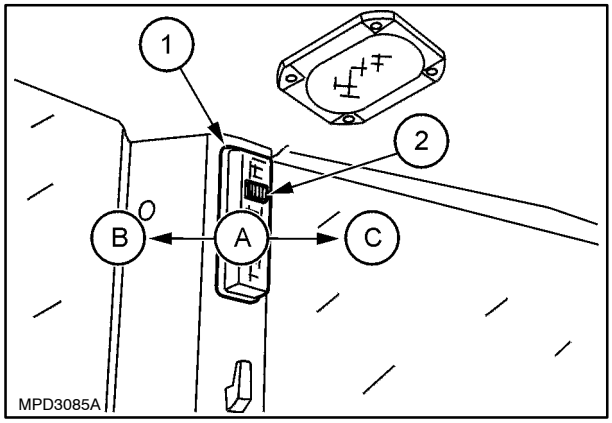
The following controls are located on the cab ceiling (Fig. 27):

1. Cab overhead lighting;
2. Air conditioner-heater controls.

Cab overhead lighting (Fig. 28)

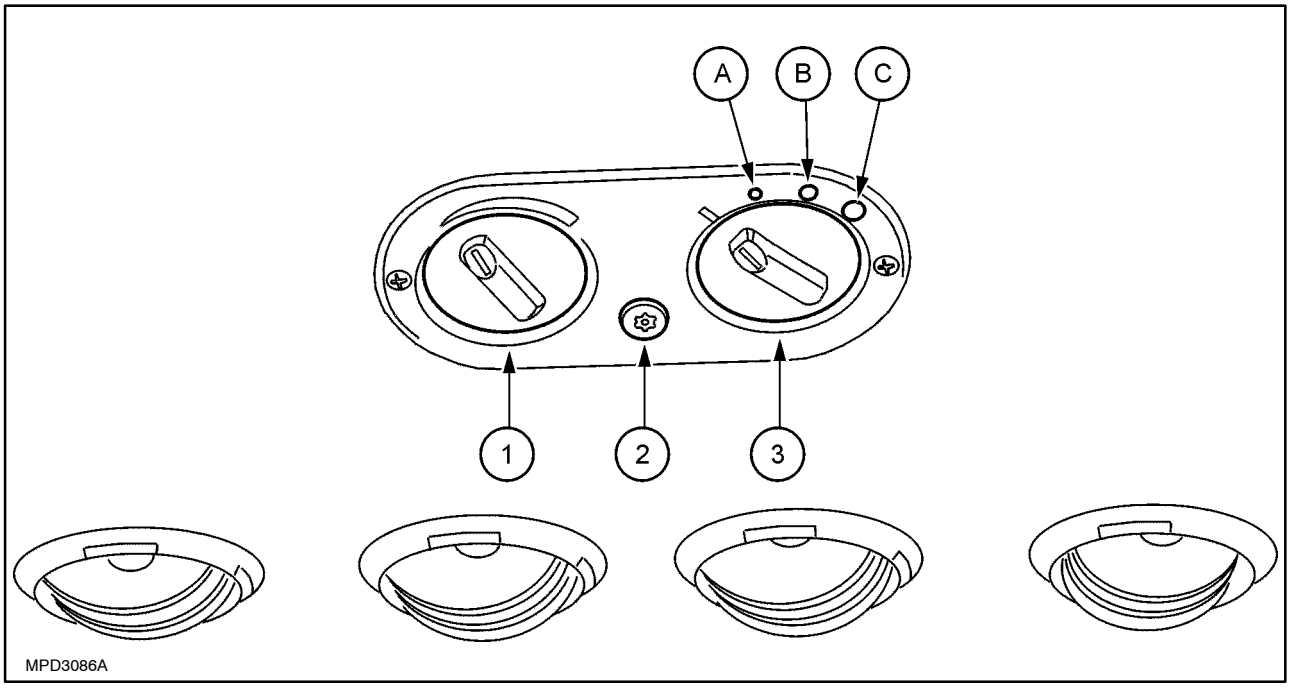
Located on the left-hand cab upright and providing three settings:

- position **A** = light OFF;
- position **B** = light ON;
- position **C** = light ON with LH door open, OFF with door closed;



28

Heater-conditioner controls (Fig. 29)



29

1. **Heater control knob**

   With the knob (1) turned fully to the right in a clockwise direction, the heater is fully ON.
   With the knob turned fully to the left in a anticlockwise direction, the water supply is interrupted and the heater is OFF.

2. **Conditioner ON push-button**

   Operates with the ignition key in the starting position.
   With the fan knob (3) on positions A, B or C, press the push-button (2) to activate the conditioner.

3. **Fan control knob**

   Operates with the starter key in position B (see fig. 15) and has three settings:

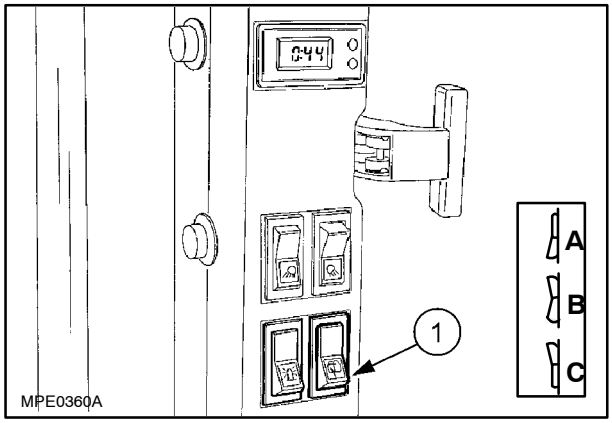
   A. Low speed
   B. Medium speed
   C. High speed

Windscreen wiper/washer switch (4, fig. 30)

Operates with the ignition key in position (B), page 7.

The rear window wiper is controlled by switch (1, fig. 30) and has three settings:

- position **A** = OFF;
- position **B** = wiper on;
- position **C** = wiper and washer on; when released the switch returns automatically to position **B**.



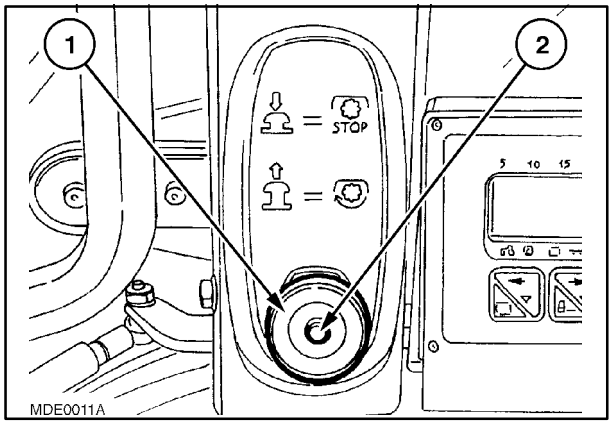
30

Electrohydraulic PTO control switch (5, fig. 31)

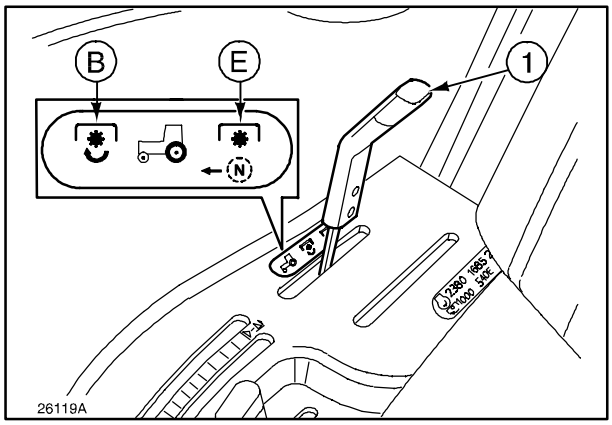
To operate the power take-off, proceed as follows:

- with knob (1, fig. 31) pressed down, select the required operation by moving lever (1, fig. 32) to position **E**.
- wait briefly, then press pushbutton (2, fig. 31) on knob (1, fig. 31) and pull the knob upwards. PTO engagement is shown by the illumination of the relevant indicator on the instrument panel.

To disengage the PTO, just press push-button (2, fig. 31).



31



32

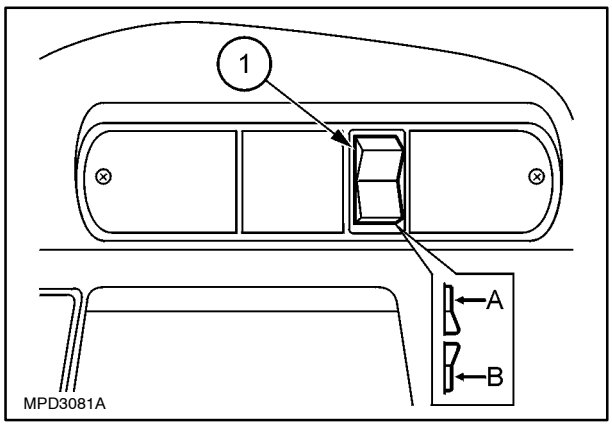
EXTERNAL CONTROLS (Fig. 33)

The external controls consist of switches (1) for lift arms up/down movement.

The switches are located at the rear of the tractor, on the LH and RH taillights. Both switches have two settings:

- position **A** = raising;
- position **B** = lowering.

By using the external controls all the control unit commands, located on the cab control panel are automatically disabled.



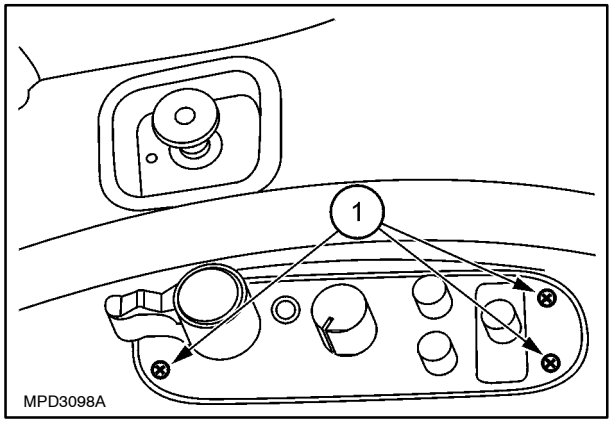
33

MAINTENANCE

Electronic lift control panel replacement (Fig. 34)

To replace the electronic lift control panel, proceed as follows:

- Unscrew the four bolts (1) and raise.
- Unscrew the connector ring nut, located behind the panel, and extract the connector.
- To install the new panel, follow the disassembly operations in reverse order.

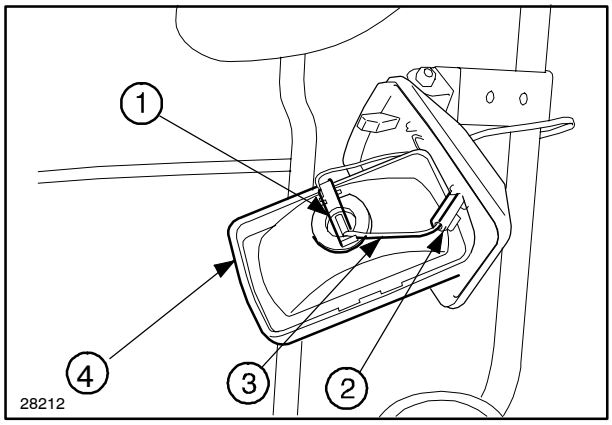


34

Work lights lamp bulb replacement (Fig. 35)

To replace the bulb, proceed as follows:

- Extract the light (4).
- Open the plastic cover (2).
- Disconnect the wire (3).
- Remove the spring (1) and extract the lamp bulb. Replace the old bulb with a new halogen bulb of the same power (12 V - 60 W).



35

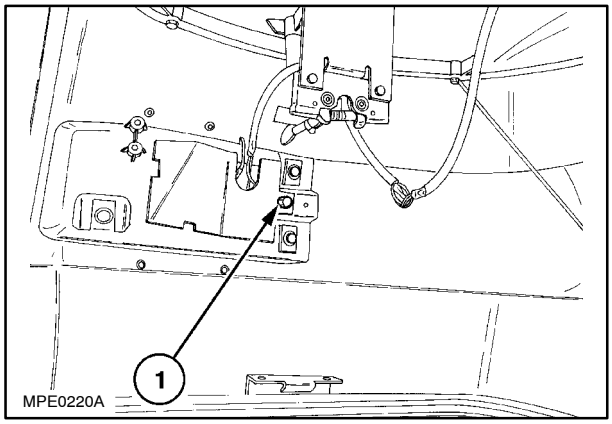
Front work lights lamp bulb replacement (Fig. 36)

WARNING

When handling halogen bulbs, only touch the metal parts, never the bulb.
If the bulb comes into contact with your fingers, adversely affecting its service life.

To replace the bulb, proceed as follows:

1. Unscrew the nut (1).
2. Remove the rear cover.
3. Replace the old bulb with a new halogen bulb of the same power (12 V - 55/60 W).



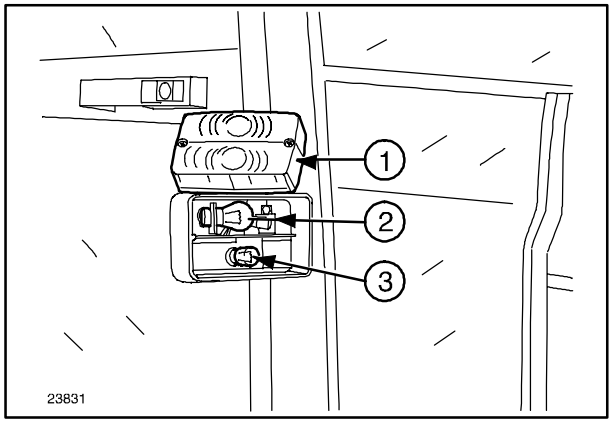
36

Front sidelight and direction indicator lamp bulb replacement (Fig. 37)

To replace the bulb, proceed as follows:

- Remove the transparent cover (1).
- Press the bulb in and twist anticlockwise to remove.
  Replace the old bulbs with new bulbs of the same power:
  - direction indicator lights (2): 12 V - 21 W;
  - sidelights (3): 12 V - 5W.

NOTE: *The transparent orange cover must be fitted facing upwards.*

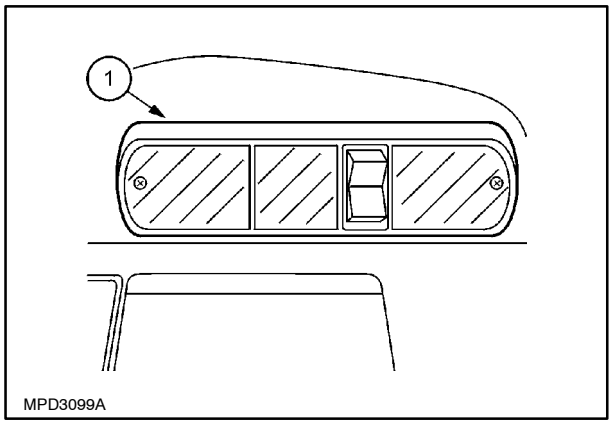


37

Tail lights, brake lights and direction indicator lamp bulb replacement (Fig. 38)

Replace burnt out bulbs as follows:

- Remove the transparent cover (1).
- Press the bulb in and twist anticlockwise.
  Replace the old bulbs with new bulbs of the same power:
  - direction indicators: 12 V - 21 W;
  - Brake lights and sidelights - double filament 12 V - 21/5 W.



38

SECTION 55 - ELECTRICAL SYSTEM

Chapter 3 - STARTING SYSTEM
(version from frame no. 1266941 for models with cab, from frame no. 1268756 for models with platform)

CONTENTS

Section	Description	Page
55 000	Technical data	1
	Tightening torques	1
	Description and operation	2
	Troubleshooting	4
	System testing	5
	Removal-Installation	7
	Bench tests	10

55 000 TECHNICAL DATA

CHARACTERISTICS	Models 70 Hp - 80 Hp - 90 Hp - 100 Hp	
Starter motor	MARELLI MT68	BOSCH JF-12V
Power (kW)	3.5	
Maximum current absorbed without load (A)	60 at 11.7 V and 7000 rpm	160 at 11.5 V and 8000 rpm
Minimum brush length in. (mm)	-	0.2755 (7.0)
Minimum switch diameter in. (mm)	1.7716 (45)	1.6732 (42.5)
Maximum armature shaft end float in. (mm)	0.0039 to 0.0157 (0.1 to 0.4)	0.0157 (0.4)

TIGHTENING TORQUES

	Nm
Starter motor and engine block assembly bolts	34
Casing on starter motor/ground wire side	16
Solenoid valve wire nuts	7
Box nuts on starter motor side	10
Solenoid valve retaining bolts	5

DESCRIPTION AND OPERATION

The type of starting system installed depends on the type of gearbox fitted on the tractor. All systems consist of an ignition key-switch, heavy-duty wiring, a starter motor with an electromagnet, a starter relay and clutch pedal switch. These are the basic circuit components used on models with a mechanical gearbox. More sophisticated systems incorporate other components, which ensure that the engine can only be started in the correct conditions.

There are four types of gearbox: synchro command, shuttle command, Dual Command (2 Speed Power Shift) and with overdrive (split command). The starter circuit is illustrated in fig. 1.

There are two types of starter motors: 2.5 kW and 3.5 kW. This motor has four poles, four brushes with integrated electromagnet and positive mesh engagement control.

The electromagnet consists of two parallel-connected windings. The low resistance intake winding is grounded via the engine, whilst the high resistance hold winding is grounded via the electromagnet body.

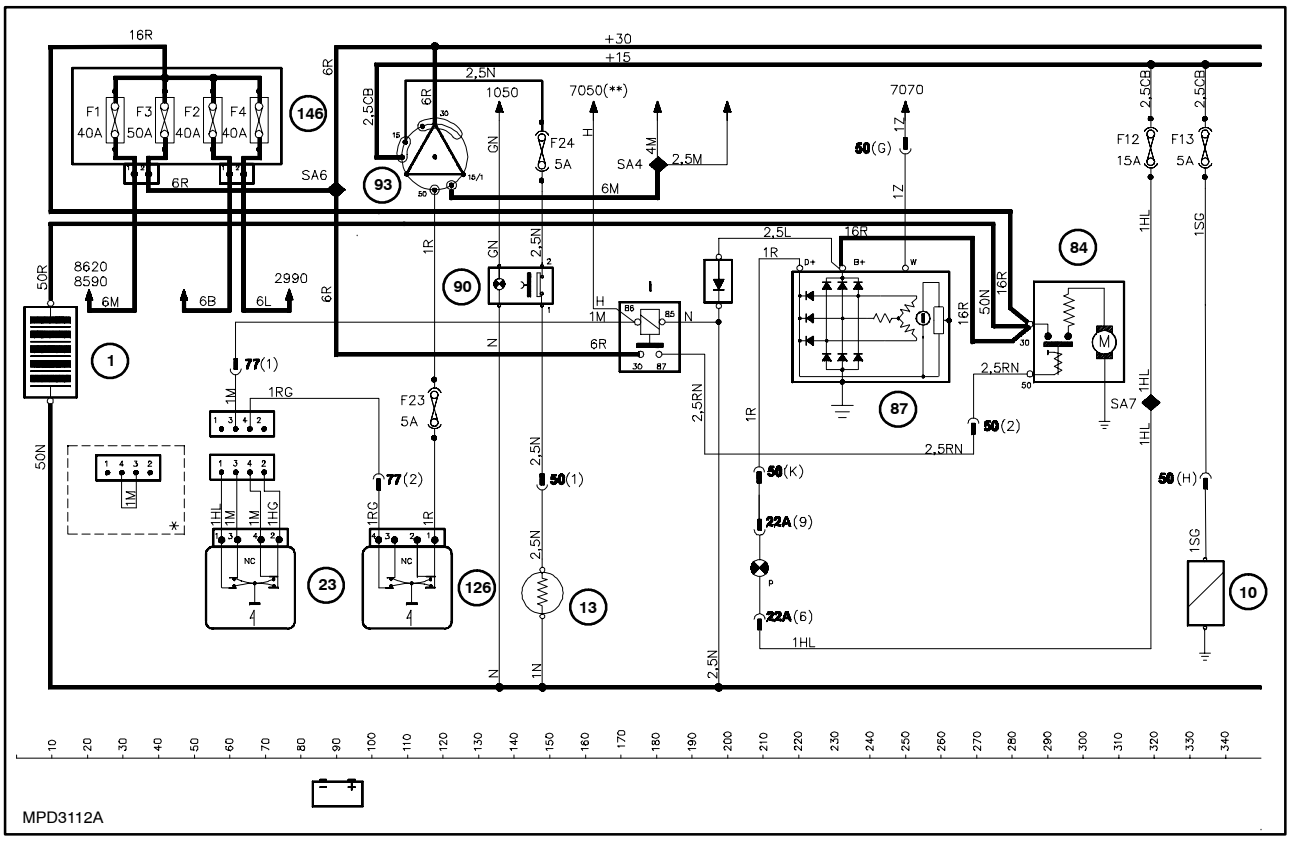
When the key-switch contact is closed with the clutch pedal pressed and the gear in neutral (unless mechanical) the coils of the electromagnet are energised and the plunger is magnetically drawn into the electromagnet. This movement, transmitted by an adjustable joint mechanism, makes the driving pinion engage the flywheel rim gear. When the pinion makes contact with the rim gear, the plunger closes a series of contacts in order to directly power-up all four field coils, thereby supplying full power to the starter motor.

At this stage, one end of the intake coil is connected to the positive battery pole through the starter switch, whilst the other end is connected to the positive battery pole through the solenoid valve contacts. In this manner the intake coil is by-passed, without absorbing power, and the hold coil exclusively maintains the electromagnet plunger in position.

The starter motor includes a series of contacts and a two-part electromagnet plunger that totally closes the contacts, even if the pinion teeth are not perfectly in line with those of the crown wheel. When this happens, a clutch spring compresses the pinion, forcing it to connect completely as soon as the starter motor starts turning.

When the key-switch is released, power to the electromagnet and motor is cut off. The electromagnet return spring, acting on the adjustable joint mechanism, frees the driving pinion from the gear and re-opens the solenoid valve contacts.

A roller-type clutch mechanism is incorporated in the driving pinion unit. This prevents the pinion from overspeeding if it remains engaged in the flywheel crown wheel after the engine has started.



1

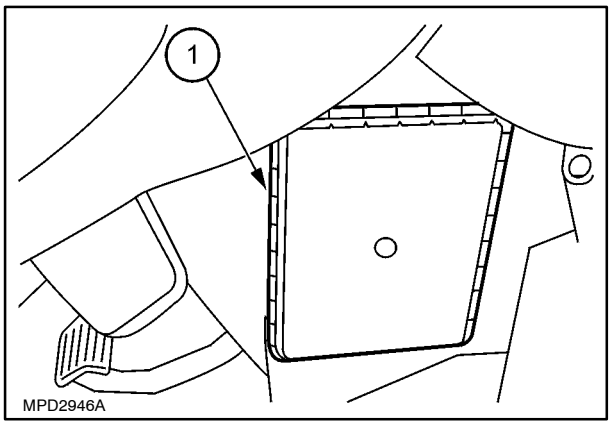
Starting circuit wiring diagram

1 Battery
10 Engine cut-out electromagnet
13 Thermostarter
15 Fuses and relay control unit
- F12 Trailer brake circuit, instruments, seat safety circuit
- F13 Engine cut-out electromagnet
- F24 Thermostarter
- I 70 A engine starter relay

22 Control panel
- p Low battery charge

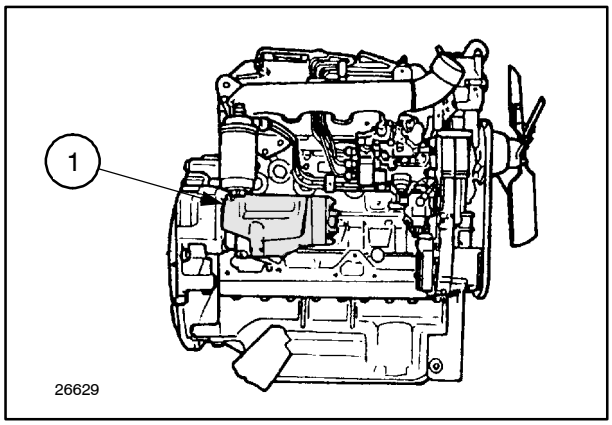
23 Electrohydraulic PTO switch
84 Starter motor
85 Over-voltage protection device
87 Alternator
90 Thermostarter switch
93 Starter switch
126 Clutch pedal switch
146 Maxi Fuse box

* Jumper for mechanical PTO version
** Lead for version with Power Shuttle



2

Fuses and relay control unit

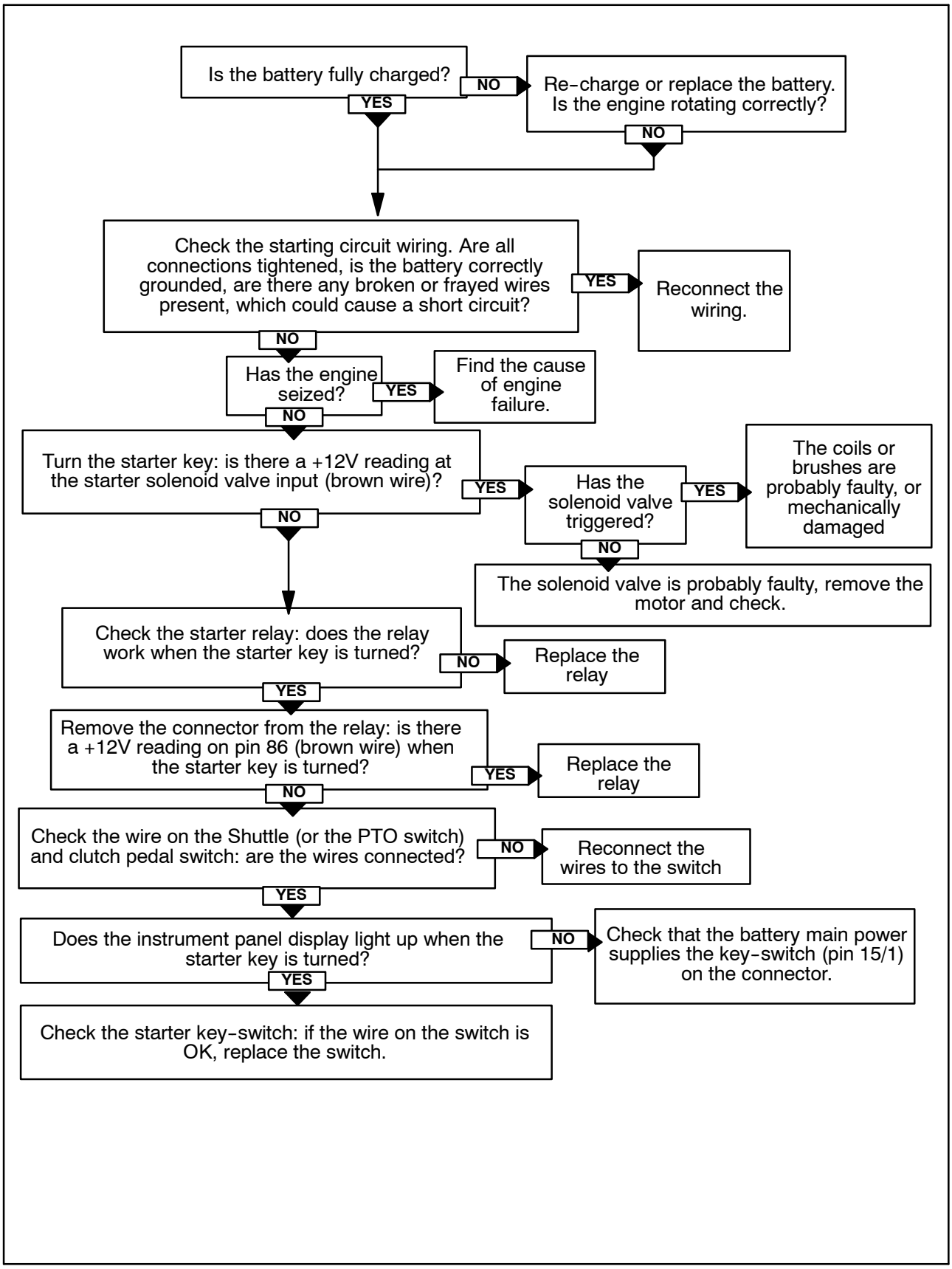


3

Starter motor

FAULT DIAGNOSIS

The engine does not turn over when the starter key is turned, with gearbox in neutral.



SYSTEM TESTING

STARTING SYSTEM TEST ON TRACTOR

To troubleshoot the starting system simply and rapidly with conclusive results, use a battery/starter tester (high discharge rate tester) with incorporated 0 to 20 V voltmeter and 0 to 500 A ammeter.

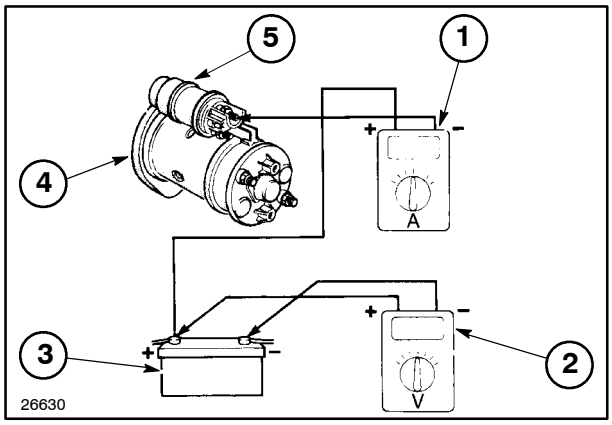
When using testing devices, follow test procedures recommended by the manufacturer. If testing devices are not available, carry out the following procedure using a standard 0 to 20 V voltmeter and a 0 to 500 A ammeter to check correct starter motor operation, without removing it from the engine.

Before the test:

- Check that the battery is fully charged.
- Check the condition of all the starting system wiring (no damaged or frayed wires, no loose connections).
- Check that the engine has not seized.

CURRENT ABSORBED ON THE STARTER MOTOR CIRCUIT (Fig. 4)

1. Disconnect the battery (3) ground cable (negative).
2. Disconnect the positive battery cable from the starter electromagnet (5). Connect the positive lead of an ammeter (1) to the positive battery terminal and the negative lead to the electromagnet input terminal (5).
3. Reconnect the ground wire (negative) to the battery negative terminal (3).
4. Connect the positive lead on the voltmeter (2) to the battery positive terminal and the negative lead to the battery negative terminal.



4

5. Disconnect the injection pump closing solenoid valve wire.
6. Run the engine and note voltmeter and ammeter readings. Voltage must remain constantly around 12 V with an absorption value of 250 to 300 A.

- If the absorption value corresponds with the technical data, the starter motor (4) is working correctly. If voltage drops during the test, carry out the “Starting system circuit resistance” test (see the relative heading).
- If the absorption value exceeds that of the technical data, check the circuit as described below. If the starting system circuit tests are satisfactory, then the starter motor is faulty and will need to be removed in order to identify the cause.
- If the current absorption value is lower than that of the technical data, then the starter motor is faulty and will need to be removed in order to identify the cause.

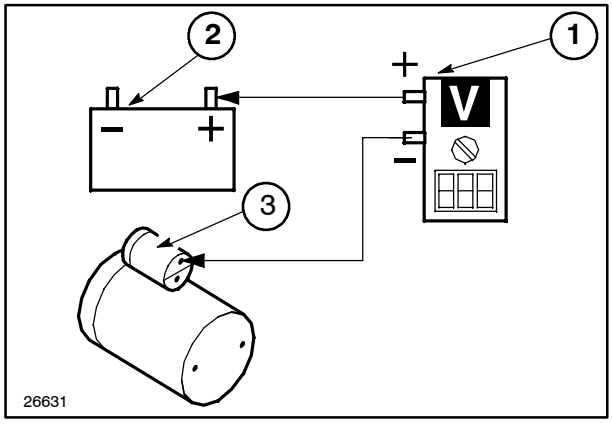
STARTING SYSTEM CIRCUIT RESISTANCE (VOLTAGE DROP) (Fig. 5)

If the voltage absorption value is too high, check the individual circuit components to find the cause of the voltage drop.

IMPORTANT: *Disconnect the injection pump shut-off solenoid valve wire.*

Positive battery cable

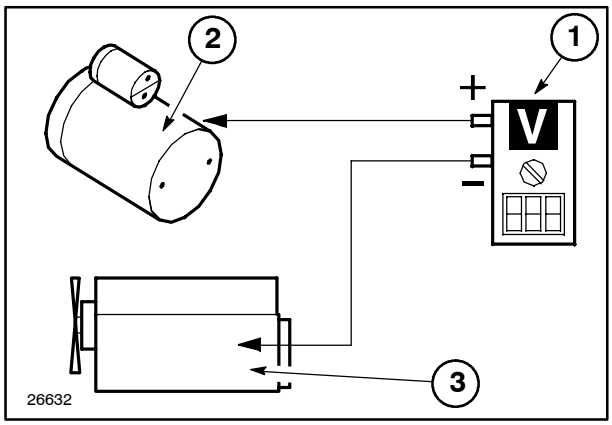
1. Connect the positive lead on the voltmeter (1) to the positive terminal on the battery (2).
2. Connect the negative lead on the voltmeter to the starter motor electromagnet terminal (3).
3. Run the engine and check the voltmeter readings. If voltage exceeds 0.2 V, check and tighten the cable connections. Re-check the voltage and, if the value is still too high, replace the cable.



5

Starter motor ground connections (Fig. 6)

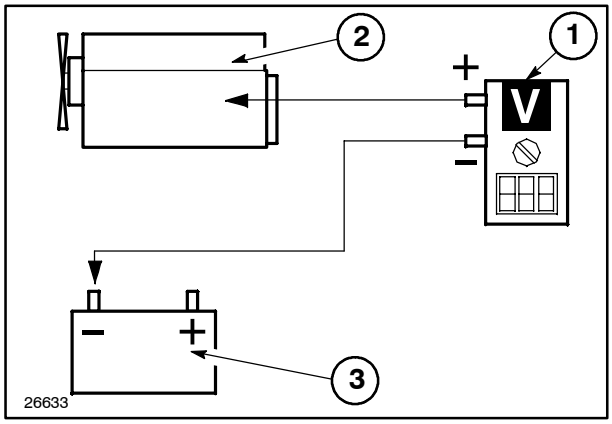
1. Connect the positive lead on the voltmeter (1) to the starter motor casing (2).
2. Connect the negative lead on the voltmeter to the engine block (3).
3. Run the engine and check the voltmeter readings. If the value exceeds 0.2 V, check the ground connections between the starter motor flange and the engine rear cover.



6

Battery ground lead (Fig. 7)

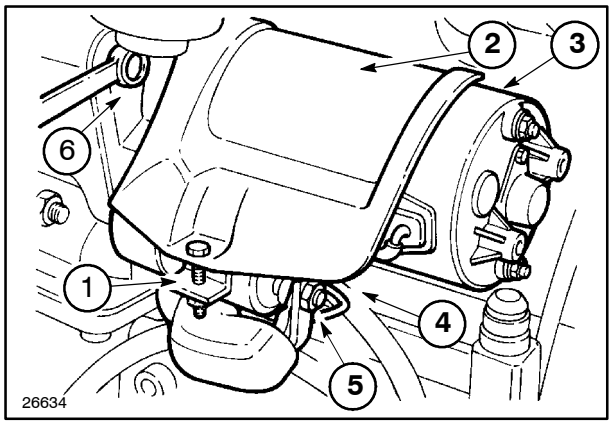
1. Connect the positive lead on the voltmeter (1) to the engine block (2).
2. Connect the negative lead on the voltmeter to the negative terminal on the battery (3).
3. Run the engine and check the voltmeter readings. If voltage exceeds 0.2 V, check and tighten the ground cable connections. Re-check the voltage and, if the value is still too high, replace the ground cable.



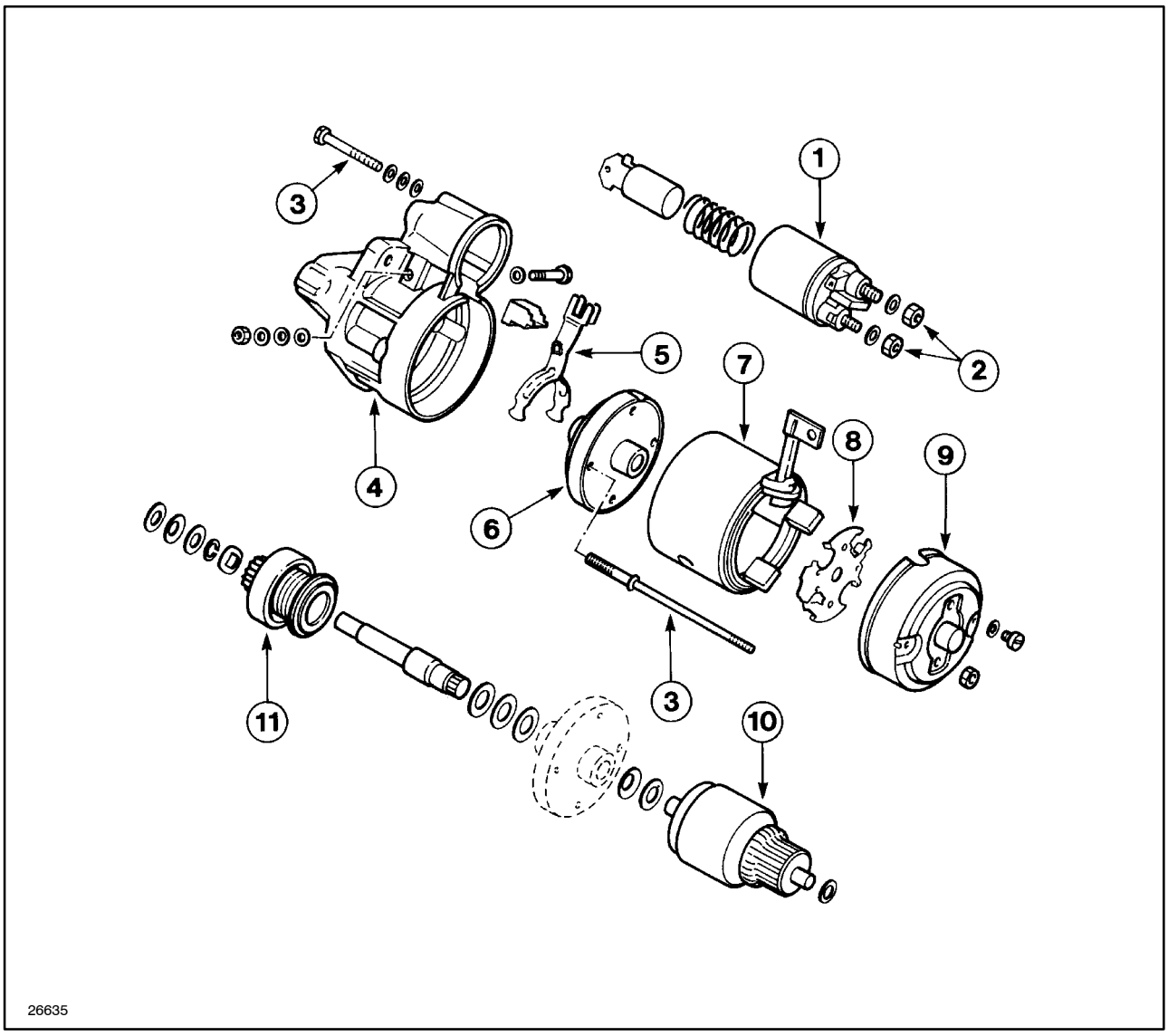
7

STARTER MOTOR REMOVAL AND INSTALLATION (Fig. 8)

1. Disconnect the battery ground lead (negative).
2. Loosen and remove the nut and bolt (1) retaining the starter motor (3) guard (2).
3. Unscrew the nut and remove the power (5) and safety switch (4) terminal.
4. Unscrew the starter motor assembly bolts (6) and extract the motor.
5. To reassemble the starter motor, carry out the removal operations in reverse order.



8



9

Starter motor components

1. Electromagnet
2. Electromagnet nuts
3. Bolt and stud assembly
4. Control side support
5. Lever
6. Reducer
7. Field coils and casing
8. Brush holder
9. Brush plate
10. Armature
11. Coupler

OVERHAUL

DISASSEMBLY

Refer to figure 9.

1. Position the starter motor in a vice with padded jaws.
2. Disconnect the biggest braided cable that connects the field coils casing with the electromagnet.
3. Remove the three screws from the front casing and extract the electromagnet. Remember that the plunger remains connected to the control lever.
4. Remove the electromagnet plunger by raising and releasing it from the control lever.

5. Remove the two nuts from the rear casing and the two screws that secure the rear cover and the brush plate to the casing. Remove the “C” clamp and the armature shaft end-float adjustment shims, leaving the brush gear on the switch. Remove the fine metal washer from the switch side of the armature.

6. At this stage of the procedure, check the brushes and the switch. Check that the brushes are not stuck together and, if necessary, clean both the brushes and the respective channels with a cloth soaked in kerosene. Also check that the brushes are not worn. If the minimum length is less than that shown in the technical data, the starter motor will need to be replaced.

NOTE: *The brushes cannot be serviced separately. They are welded to their support and do not require replacement during the entire operating life of the starter motor.*

7. Extract the motor casing from the armature and the bracket on the control side.

8. Extract the control lever knuckle pin from the control side of the casing.

9. Remove the circlip that holds the control unit and the inner plate to the armature shaft, by first removing the circlip retaining collar perpendicularly using a suitably sized piece of piping. Then lever the circlip from the groove.

10. Extract the armature and control unit.

REASSEMBLY

1. To reassemble the starter motor, carry out the disassembly operations in reverse order.

Before reassembly, check the armature end float and test the starter motor (without load).

Checking armature end float

1. Position the starter motor in a vice with padded jaws and connect a dial gauge to the flange on the control side of the casing. Position the dial gauge pointer on the end of the armature shaft.

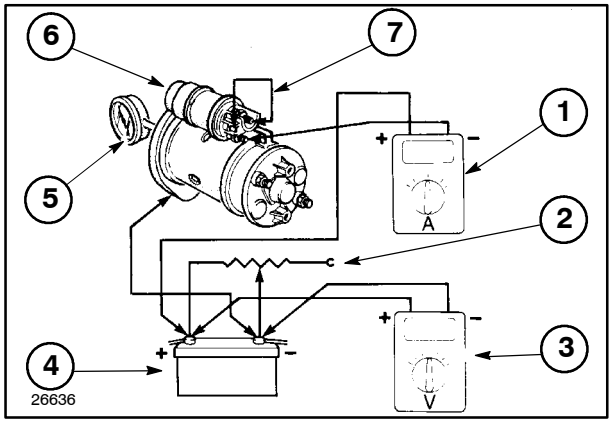
2. Push the armature fully forward and zero-set the dial gauge. Push the armature fully back and note the reading on the instrument.

3. Readings must fall within the limits specified in the technical information table. If the value is higher, check the armature and brush plate are not worn. Replace worn parts and, if necessary, check the end float again.

Starter motor test (without load) (Fig. 10)

NOTE: *A fully charged battery and a battery/starting tester (high discharge rate tester) with a carbon battery (variable load resistance) are required to carry out this test.*

1. Position the starter motor in a vice with padded jaws.
2. Connect the negative cable on the battery (4) to the starter motor assembly flange.
3. Using a short cable, make a bridge (7) between the electromagnet contacts (6).
4. Connect the positive lead on a voltmeter (3) to the positive terminal on the battery (4) and the negative lead to the negative terminal on the battery. Connect the positive lead on the ammeter(1) to the positive terminal on the battery (4) and the negative lead to the battery or the starter motor terminal.
5. Position a manual tachometer (5) on the end of the armature shaft. The maximum power absorption, which is a specific value for each starter motor, must be within the range of values shown on the TECHNICAL DATA table. Adjust the carbon battery voltage (2) and the armature rpm to the values shown on the table.
6. If the starter motor does not work according to the technical data specifications, check to see if the field coils are grounded, the armature scrapes or if the armature shaft is deformed.



10

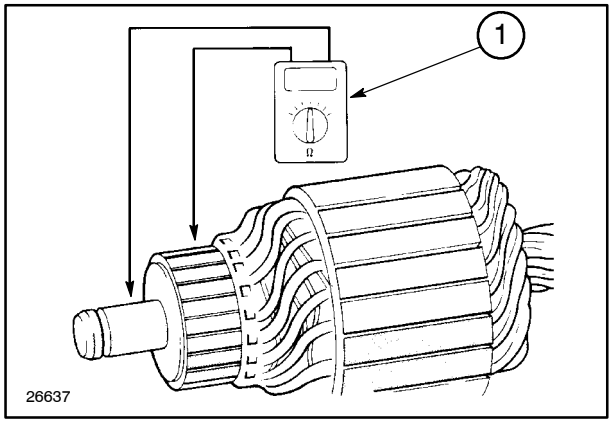
BENCH TESTS

Armature (Fig. 11)

1. The switch surface must be clean and not burnt. If necessary, remove the burn stains with fine sandpaper - not emery cloth. Finally, clean the switch with a cloth soaked in kerosene.
2. If the switch needs re-facing, make sure that the diameter is not below the minimum value prescribed in the TECHNICAL DATA table. After re-facing, the switch must be polished with fine sandpaper and cleaned with a cloth soaked in kerosene.

NOTE: *Do not cut the armature metal when making insulation slots.*

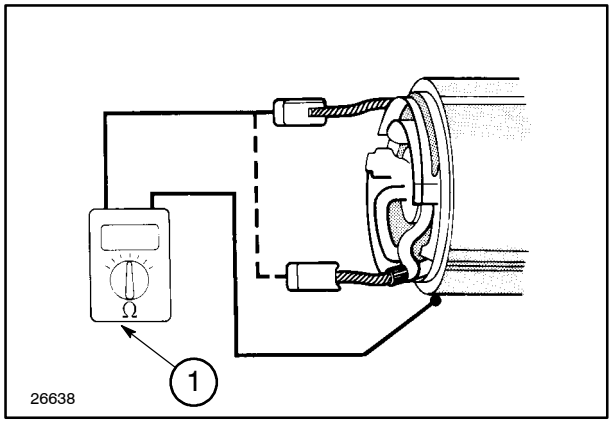
3. Armature insulation can be checked by connecting an ohmmeter (1) between switch segments and the armature shaft. This reading should show infinity, i.e.: there should be no continuity.
4. To test for short circuits in the armature, use a suitable test instrument or, as the only alternative, try replacing the armature.
5. If the armature circumference has obviously made contact with the pole pieces, the pole bearings are probably too worn. First check that the pole pieces are fixed and that the armature rotates correctly in a lathe. If necessary, replace the armature bearings.



11

Field coils (Fig. 12)

1. To test the field coils insulation, connect an ohmmeter to each of the coil brushes in turn and to a clean and unpainted area of the casing. No readings should be taken, i.e.: there should be no continuity.
2. To test the field coils continuity, connect an ohmmeter to each of the coil brushes in turn and to the main power terminal (the biggest braided cable). The reading should be 1 Ω.
3. If there is a fault in the field coils, replace the entire box and field coils system.



12

Bearing bushings

1. Check if the bushing on the brush plate and the box on the drive pinion side are worn. Assemble the armature shaft and note play. Replace the bushings if end float is excessive. Check the field poles to see if there are any signs of scraping against the casing. This could also be caused by worn bushings.

Drive pinion

1. Check roller clutch operation. The pinion must only rotate clockwise. If the pinion is either locked or spins in both directions, or if the pinion teeth are damaged, assemble a new control unit.

If there is clear evidence of damage to pinion teeth, check the flywheel crown wheel teeth too.

SECTION 55 - ELECTRICAL SYSTEM

Chapter 4 - CHARGING SYSTEM
(version from frame no. 1266941 for models with cab, from frame no. 1268756 for models with platform)

CONTENTS

Section	Description	Page
55 000	Technical data	1
	Tightening torques	1
	Description and operation	2
	System testing and troubleshooting	4

55 000 TECHNICAL DATA

CHARACTERISTICS	TYPE OF ALTERNATOR	
	MAGNETI MARELLI AA125R-14V-45A	**BOSCH 14V-65A**
Polarity	Grounded negative	
Nominal voltage (V)	14	
Max rotation speed (rpm)	15.000	
Maximum output (A)	45	65
Regulator controlled voltage (V)	13.6 to 14	13.6 to 14.4
Rotor field winding resistance (Ω)	3.4 to 3.8	2.9
Stator field winding resistance (Ω)	-	0.2
New brush length in. (mm)	-	0.7874 (20)
Minimum brush length in. (mm)	-	0.1968 (5)
Brush spring force (N)	-	1.3 to 2.7

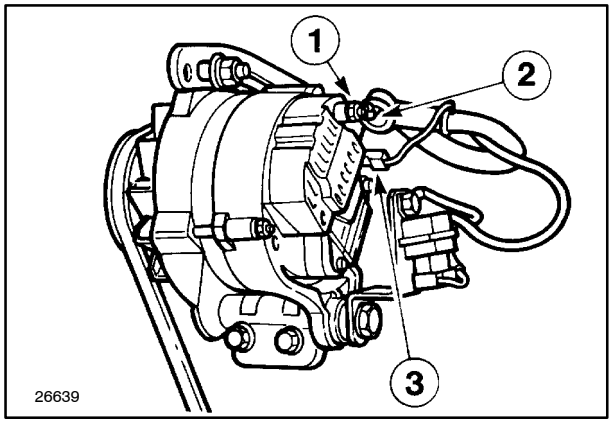
TIGHTENING TORQUES

	Nm
Alternator fastening bolts	5.5
Pulley retaining nut	70
Rectifier fastening screws	4.0
Brush box and regulator screws	2.7
Terminal nuts	2.7

DESCRIPTION AND OPERATION

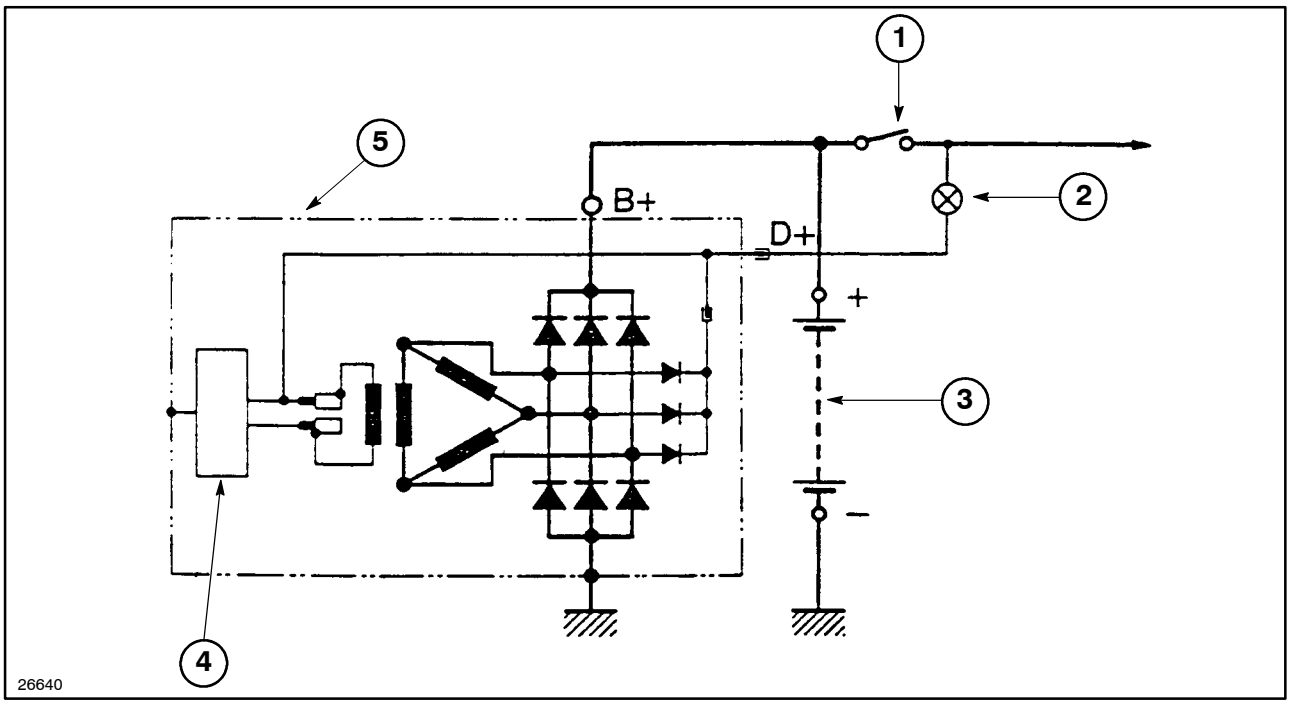
ALTERNATOR DESCRIPTION

A Magneti Marelli-type 45 or 65 A external cooling fan alternator is fitted on all models. The stator winding is ventilated with an air conducting diaphragm in the support on the rectifier bridge side and peripheral openings in the support on the control side. The alternator, installed on the left-hand side of the engine, is operated by a pulley and a V-type driving belt. Alternators are fitted with a built-in regulator.



1

1. Battery connection (B+ terminal)
2. Terminal protection sheath
3. Alternator charge indicator connection (D+ terminal)



2

Alternator charging circuit

1. Starter switch
2. Alternator charge warning light
3. Battery
4. Alternator electronic voltage regulation circuit
5. Alternator
B+: Battery connector
D+: Alternator charge indicator

ALTERNATOR FUNCTIONING

Refer to figure 2.

When the starter key is turned, low current passes from the battery through the rotor field wiring. The circuit closes, powering the charge warning light, the alternator D+ terminal, the rotor field winding, the alternator regulator and ground.

At this point the warning light illuminates and the rotor is partially magnetised.

When the engine starts and the rotor, partially magnetised, turns inside the stator windings and generates three-phase alternating current. A constant quantity of this current is transformed into direct current by three field diodes built into the rectifier.

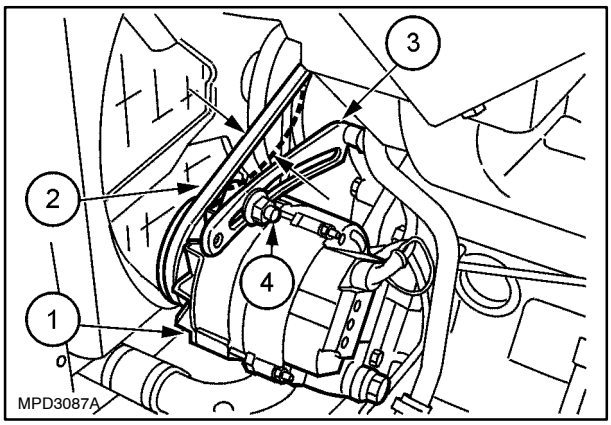
The direct current is then reintroduced into the circuit to increase current flow through the rotor field winding.

This action causes a constant increase in the rotor magnetic field and a fast increase of current and voltage output.

As the generated voltage output (reflected by D+ terminal) increases, the warning light intensity decreases and when the voltage at the D+ terminal equals that on the battery side of the warning light, the light goes out.

Voltage continues to increase until it reaches the pre-stabilised regulated voltage level.

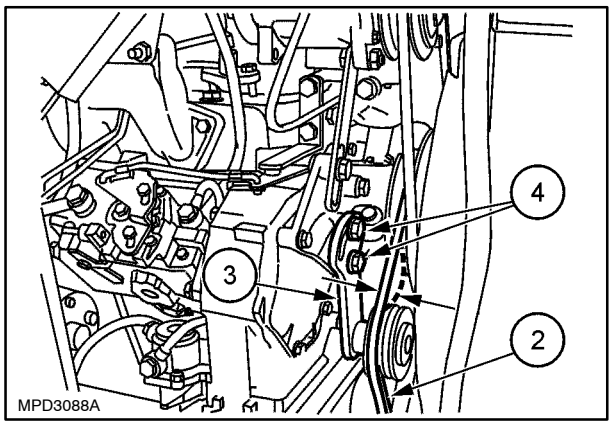
If the driving belt breaks, there will be no voltage accumulation in the alternator. The charge warning light will remain on - indicating the presence of a fault.



3

Fig. 3. Belt for models without air conditioning

1. Alternator
2. Belt



4

Fan belt tensioner

Fig. 4. Belt for models with air conditioning

3. Belt tensioner
4. Belt tensioner securing nut

SYSTEM TESTING AND TROUBLESHOOTING

PRECAUTIONS

To avoid damaging alternator charging system components, take the following precautions:

- **NEVER MAKE OR BREAK** any charging circuit connection, including the battery, when the engine is running.
- **NEVER SHORT CIRCUIT** the alternator positive terminal to check if it is working.
- **ALWAYS DISCONNECT** battery cables when re-charging the battery on the tractor with a battery charger.
- **ALWAYS CHECK** battery polarity when installing a battery or using a supplementary battery to start the engine.
- **DO NOT SHORT CIRCUIT** regulator input/output terminals whilst the alternator is working.
- **CONNECT POSITIVE TO POSITIVE AND NEGATIVE TO NEGATIVE.**

PRELIMINARY CHECKS

Before carrying out electrical tests, carefully inspect the charging system and the electrical system in general.

Check continuity in all conductors and connections, making sure they are correctly tightened.

1. BATTERY CHECK

Check all battery elements with a densimeter. The battery must be at least 70% charged and efficient.

2. DRIVING BELT CHECK

Inspect the alternator driving belt and pulley, making sure that they are both clean and in good condition, with no traces of oil or grease.

Periodically check the alternator driving belt tension. If the belt tension is insufficient, check the belt tensioner as indicated below.

Belt for models without air conditioning (Fig. 3).

- loosen the nut (4) that fastens the alternator to the tensioner bracket (3).
- with a lever, move the alternator (1) on the tensioner bracket (3) until the correct tension on the belt is reached, then tighten the retaining nut (4) to a torque value of 55 Nm.

Belt for models with air conditioning (Fig. 4).

- loosen the tensioner (3) locknuts (4).
- move the belt tensioner arm (3) on the bracket until the correct tension is reached,

then tighten the retaining nut (4) to a torque value of 55 Nm.

Correct deflection values, measured by applying the following loads to the middle of the belt:

	Model without cab, or with cab without air conditioning	Model with cab, with air conditioner
Load (N)	78 to 98	60 to 75
Deflection in. (mm)	0.3937 to 0.4330 (10 to 11)	0.3937 (10)

3. CHECKING THE WARNING LIGHTS ON THE CONTROL PANEL

Turn the ignition key and check the light is completely lit.

If the warning light does not illuminate completely, check the light bulb. If the light bulb is in working order, carry out the alternator wire connection tests, as described under the heading "PRELIMINARY TESTS" in this section.

If the light is on, start the engine and run it above minimum speed. The warning light should switch off.

If the warning light does not go out, stop the engine and disconnect the D+ terminal wire. If the warning light goes out now, one of the alternator components is malfunctioning. Carry out the "ALTERNATOR COMPONENTS TEST", as described in this section.

If the warning light remains on, check that there are no grounded short circuits between the D+ wire endings and the warning light.

PRELIMINARY TESTS

The preliminary tests can be carried out without removing any components from the tractor charging circuit. The tests check:

- the alternator wiring connections
- the alternator charging current and controlled voltage
- voltage drops in the alternator charging circuit
- maximum alternator output

The following testing devices are required:

- 0 to 30 V mobile coil voltmeter
- 0 to 1 V millivoltmeter
- 0 to 110 A mobile coil ammeter
- 1.5 Ohm 110 A variable load resistor.

NOTE: *Most commercially available testing devices include several devices in the same case. Use these devices according to the manufacturer's instructions.*

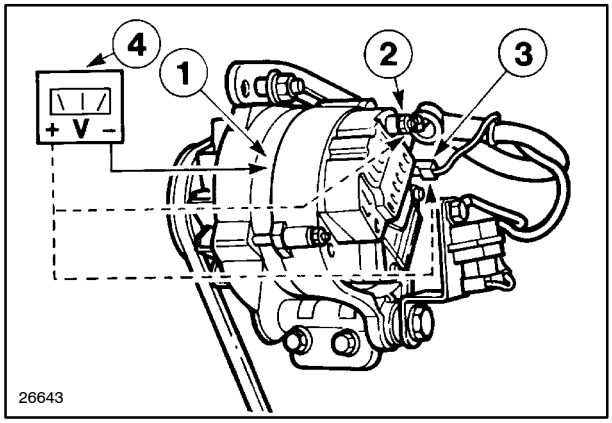
1. ALTERNATOR WIRE CONNECTION TESTS

See figure 5.

1. Disconnect battery.
2. Disconnect terminals B+ (2) and D+ (3) on the alternator.
3. Reconnect the battery and turn the starter key to ON, without starting the engine. Connect a voltmeter (4) between each terminal and earth (ground) (1). Voltage must be present at the battery.

If there is no voltage at the battery, find and repair the continuity failure in the external wire circuit. See the circuit diagram in figure 2.

4. Connect the D+ terminal warning light (red) to earth (ground). The warning light should switch on.
5. Disconnect the battery and reconnect the previously disconnected connectors to the alternator.



5

NOTE: *If the warning light does not switch on when the wire is reconnected to the alternator, there is a fault either in the alternator regulator or the rotor circuit. Check D+ terminal is clean and then test the alternator components as described in this section.*

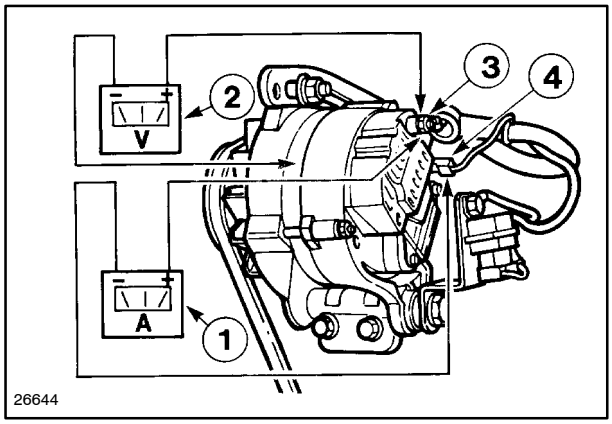
---

2. CHARGING CURRENT AND REGULATED VOLTAGE TESTS

Refer to figure 6.

1. Make sure that all tractor electrical devices are switched off and that the starter key is in the OFF position.
2. Disconnect the battery negative terminal and the B+ alternator terminal (3).
3. Connect an ammeter (1) between the disconnected wire (red) (4) and the alternator B+ terminal.
4. Connect a voltmeter (2) between the B+ alternator terminal and earth (ground).
5. Reconnect the battery. Start the engine and run at 2000 rpm. Note the readings on the voltmeter and ammeter.

The voltmeter readings should be higher than those of the battery and, when the ammeter reading drops below 10 A, the voltmeter reading stabilises at 13.6 to 14 V (Magneti Marelli alternator) or 13.6 to 14.4 V (Bosch alternator).



6

If the voltmeter reading is higher than 14 V, or 14.4 V for Magneti Marelli or Bosch alternators, the alternator regulator must be replaced, as described in this section. (After installing a new regulator, carry out tests 4 and 5).

If the voltmeter reading is less than 13.6 V, there is either a faulty component in the alternator or a failure due to excessive resistance in the external charging system connections.

If the ammeter indicates zero A, one of the alternator components is faulty. Switch off the engine and carry out alternator components test, as described in this chapter.

3. CHARGING CIRCUIT VOLTAGE DROP TESTS

(a) Insulated side voltage drop tests

Refer to figure 7.

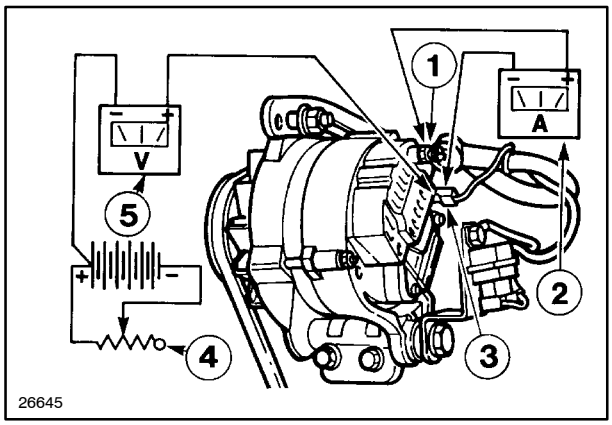
Check the ignition key is in OFF position.

1. Disconnect the negative battery cable and the B+ alternator wire (1).
2. Connect a millivoltmeter (5) between the positive battery terminal and the D+ wire (3) (positive side of the wire).
3. Connect an ammeter (2) between the B+ alternator terminal and the D+ wire (negative side of the wire).
4. Reconnect the negative battery cable and connect a variable load resistance (4) with the cursor in the minimum current absorption position (maximum resistance) through the battery terminals.
5. Start the engine and increase speed to 2000 rev/min.
6. Gradually increase the resistance charging load (decreasing the resistance) until the ammeter indicates 45 or 65 A, according to the type of alternator.
7. Note the reading on the millivoltmeter, which should not exceed 400 millivolt.

Readings higher than 400 millivolt indicates a fault due to excessive resistance on the external circuits.

If the alternator cannot produce the requested output and the reading on the millivoltmeter is lower than 400 millivolt, there is a faulty component in the alternator. Carry out the alternator component tests as described in this section.

8. Stop the engine.



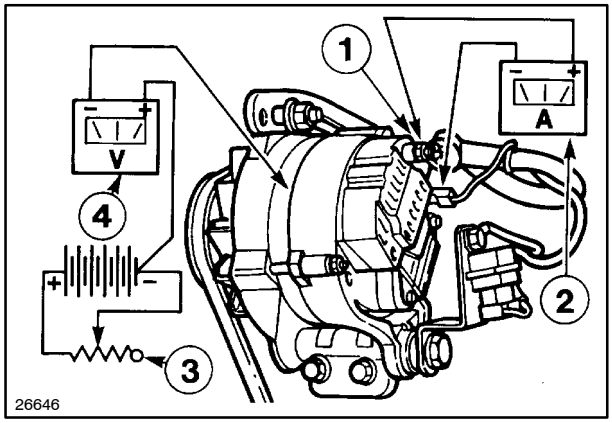
7

(b) Ground side voltage drop test

Refer to figure 8.

1. Check the ignition key is in OFF position.
2. The circuit is the same as that described in the previous test, except that the millivoltmeter (4) is now connected between the negative battery terminal and the alternator casing (negative side of the casing).

NOTE: *Make sure that the variable load resistance (3) is in the minimum current absorption position (maximum resistance).*



8

3. Start the engine and increase speed to 2000 rpm.
4. Gradually increase the resistance charging load (decreasing the resistance) until the ammeter (2) indicates 45 or 65 A, according to the type of alternator.
5. Note the reading on the millivoltmeter, which should not exceed 200 millivolt.

A reading higher than 200 millivolts indicates malfunctioning due to excessive resistance in the external circuits.

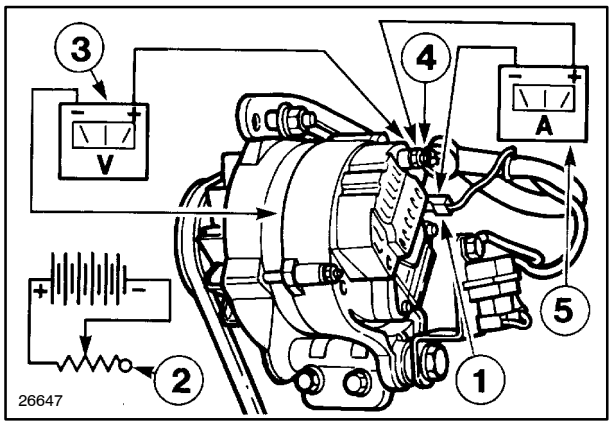
If the alternator cannot produce the requested output and the reading on the millivoltmeter is lower than 200 millivolt, there is a faulty component in the alternator. Carry out the alternator component tests as described in this section.

6. Stop the engine.

4. MAXIMUM ALTERNATOR OUTPUT TEST

Refer to figure 9.

1. Check the ignition key is in OFF position.
2. Disconnect the negative battery cable and the alternator B+ wire (4).
3. Connect an ammeter (5) between the B+ alternator terminal (4) and the D+ wire (1) (negative side of the wire).
4. Connect a voltmeter (3) between the alternator B+ terminal (4) and earth (ground).
5. Reconnect the battery, start the engine and increase speed to 2000 rpm.



9

6. Gradually increase the resistance charging load (2) (decreasing the resistance) until the ammeter indicates 45 or 65 A. according to the type of alternator.
7. Note that the voltmeter reading does not fall below 13.6 V.

Readings of less than 13.6 V indicate the presence of a faulty alternator component. Carry out the alternator component tests as described in this section.

ALTERNATOR COMPONENT TESTS

The alternator component tests must only be carried out if the INITIAL CHECKS have shown the presence of a faulty alternator component, allowing the following checks to be performed:

- the regulator,
- rotor field winding continuity,
- rotor brushes, springs and contact rings.

NOTE: *The previously described component tests can be carried out with the alternator installed on the tractor. In order to carry out the other alternator component tests, remove the alternator from the tractor. See the section REMOVAL, INSTALLATION AND OVERHAUL in this chapter.*

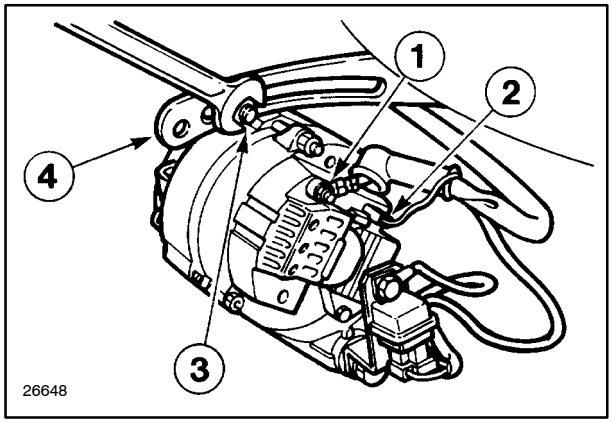
REMOVAL, INSTALLATION AND OVERHAUL

IMPORTANT: *Before disconnecting the alternator wires, make sure that the starter key is in the OFF position.*

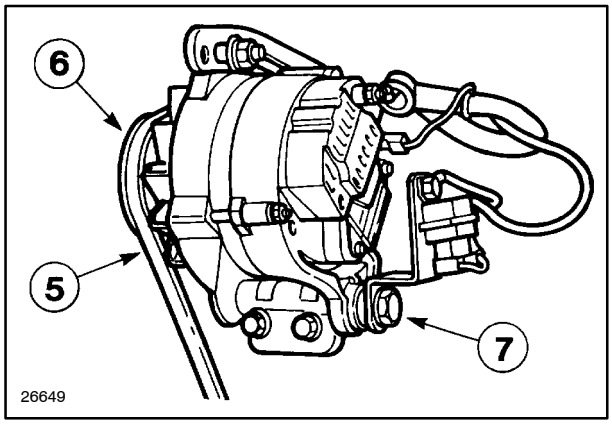
REMOVING THE ALTERNATOR

Refer to figures 10 and 11.

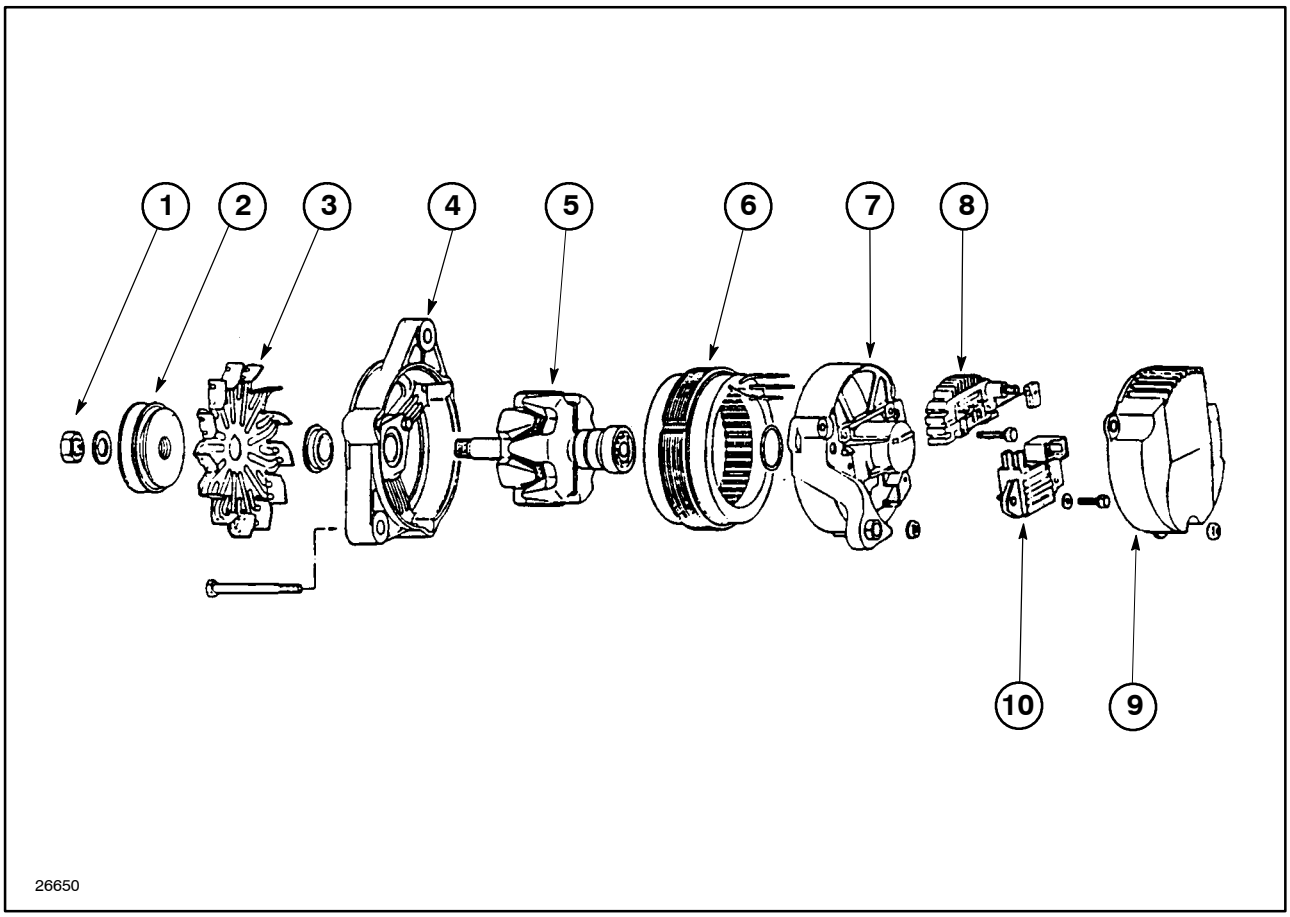
1. Disconnect the battery negative lead.
2. Disconnect the two wires B+ (1) and D+ (2) from the alternator.
1. Loosen and remove the nut and bolt (3) securing the alternator to the belt tensioner (4).
2. Move the alternator to slacken the belt (5) tension, then remove from the alternator pulley (6).
3. Fully unscrew the nut (7) and remove, together with the bolt, then remove the alternator.



10



11



12

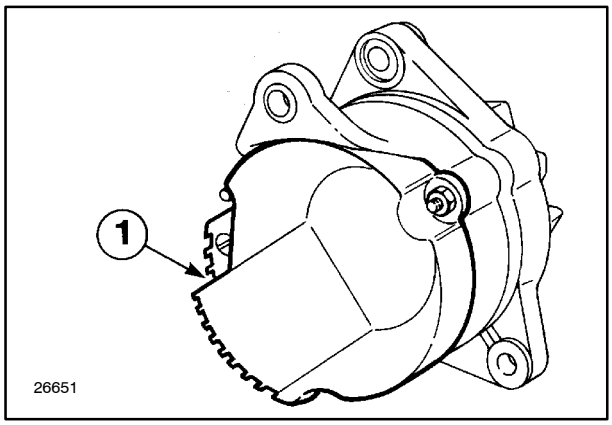
Alternator Components

1. Pulley retaining nut
2. Pulley
3. Cooling fan
4. Front support plate
5. Pump rotor
6. Stator
7. Rear support plate
8. Rectifier bridge
9. Guard
10. Electric voltage regulator with incorporated brushes

Firmly fix the alternator horizontally to an appropriate holder with internal surfaces protected with soft material.

Remove the guard (1) after having unscrewed the alternator retaining nuts (Fig. 13).

Before dismantling the alternator completely, carry out the operations and checks described on the following pages.



13

ROTOR AND REGULATOR FIELD CIRCUIT TEST

The following testing devices are required:

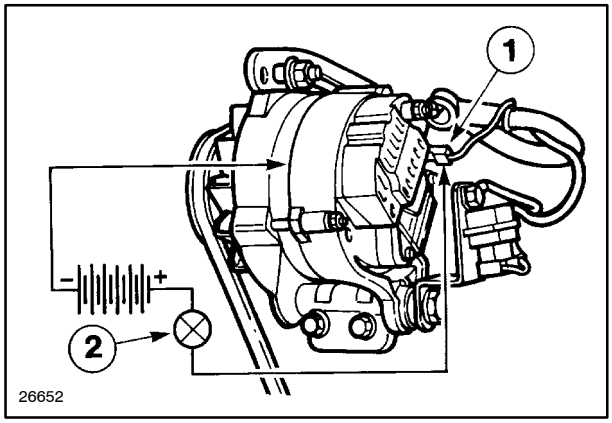
- 12 V battery
- multi-function tester
- 2 watt test lamp.

Refer to figure 14.

1. Disconnect all alternator wires.
2. Connect a 12 V battery and a 2 watt test lamp (2) in series between D+ (1) and the alternator casing (negative side of casing).
3. The test lamp should light up.

If the test lamp does not light up, then the rotor circuit is faulty. Check brushes, contact rings and rotor field winding continuity.

If the test shows that these components work satisfactorily, then the regulator may be faulty.

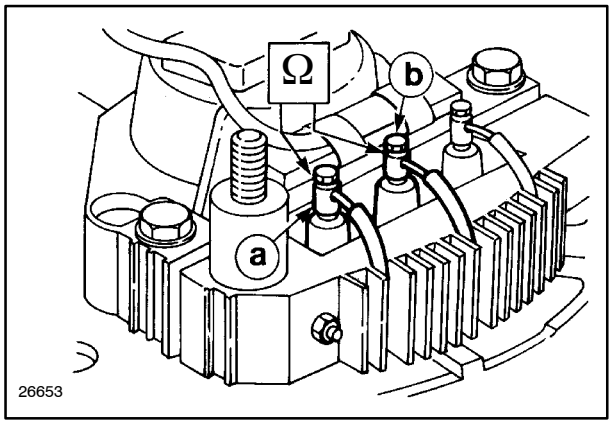


14

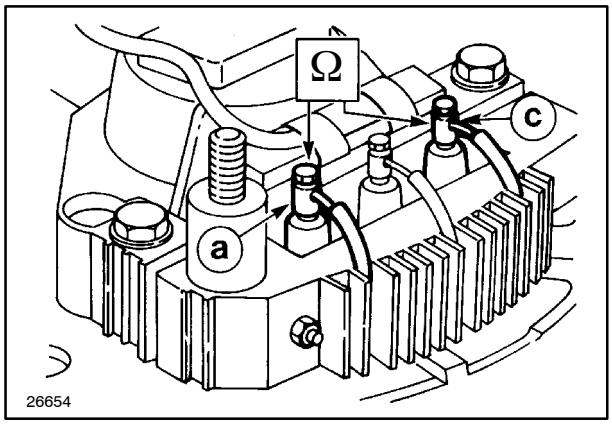
CHECKING THE CONTINUITY OF THREE STATOR WINDINGS

Position the points of an ohmmeter (adjusted to the Ω x1 scale) so that they touch the stator phase ends (a - b - c) in the three possible ways shown in figs. 15 - 16 - 17. Each of the three readings should show the same resistance value.

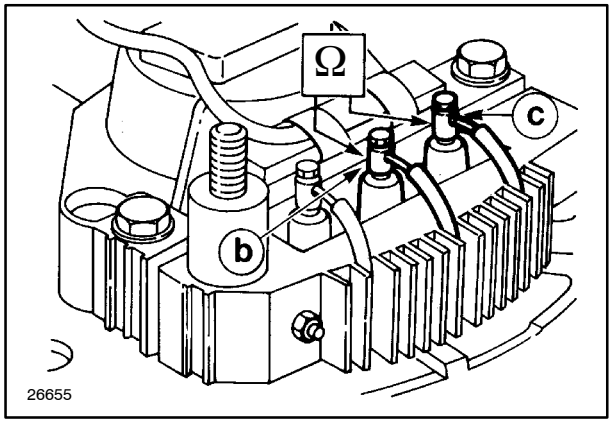
If resistance is infinite or zero, the measured phase is either interrupted or short-circuited, therefore the stator will need to be replaced.



15



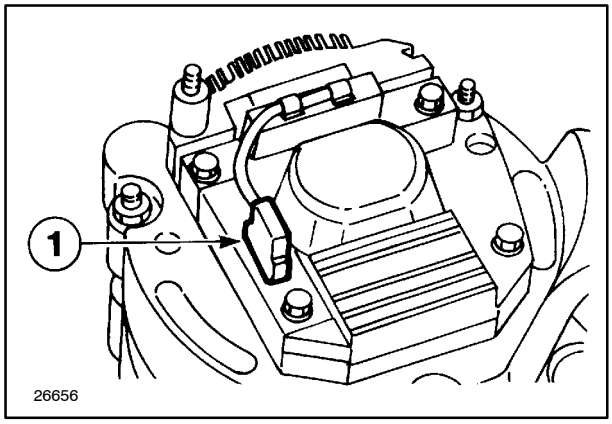
16



17

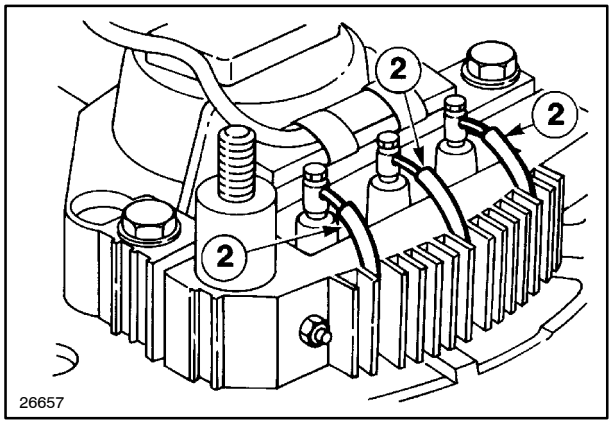
CHECKING THE DIODES

Disconnect the terminal wire connector (1) of the excitation diodes from the positive brush pin (Fig. 18).



18

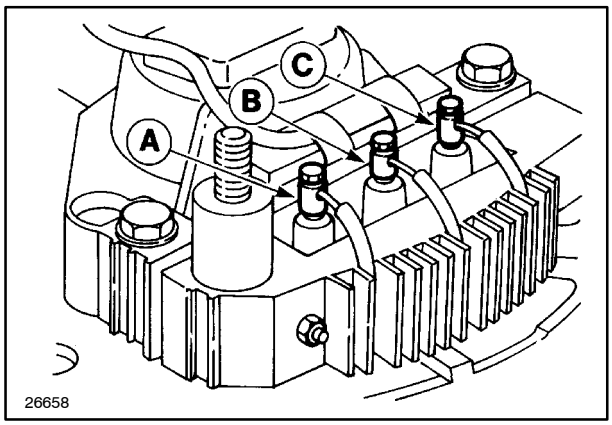
Unweld stator winding terminals (2) from the rectifier bridge (Fig. 19).



19

EXCITATION DIODES TEST

Insert an ohmmeter point in the connector (1) mentioned above (Fig. 18).
The second point must be placed in contact with each of the three terminals (A-B-C). Repeat the three measurements after inverting the instrument points (Fig. 20).

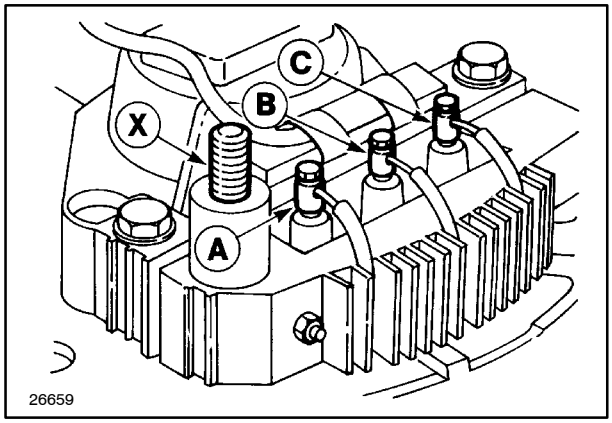


20

POSITIVE POWER DIODE TESTS

Place an ohmmeter point in contact with the positive (X) alternator terminal and the other successively with each of the three terminals (A-B-C) (Fig. 21).

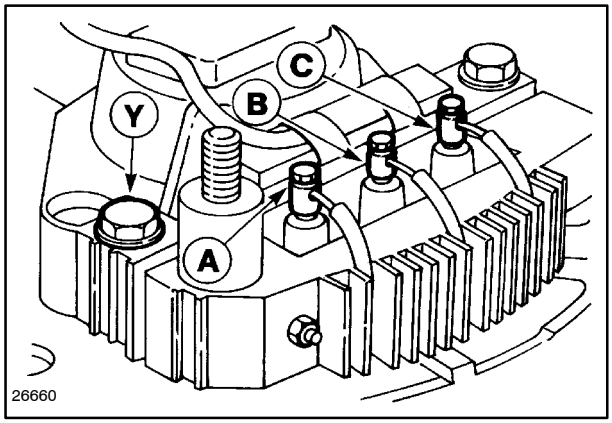
Repeat the three measurements after inverting the instrument point connections.



21

NEGATIVE POWER DIODE TESTS

Place an ohmmeter point in contact with negative (Y) diode plate and the other successively with each of the three terminals (A-B-C) - (Fig. 22).
Repeat the three measurements after inverting the instrument point connections.



22

In the three tests described above, the instrument should show resistance at each terminal (A-B-C). Inverting the instrument points, there should be no resistance (Fig. 22). If there is resistance in both cases, then the diodes are short-circuited. Otherwise, with an R=0 value (interrupted diode), replace the entire rectifier bridge.

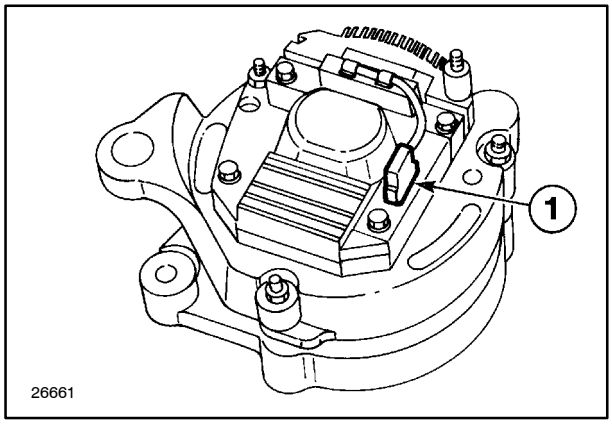
ROTOR

CHECK ON ROTOR WINDING RESISTANCE MEASURED BETWEEN PINS CONNECTED TO BRUSHES

Disconnect the excitation diode terminal wire connector (1) from the pin connected to the positive brush.

Place both points of an ohmmeter (regulated on a Ω x 1) in contact with the two voltage regulator-brush holder pins.

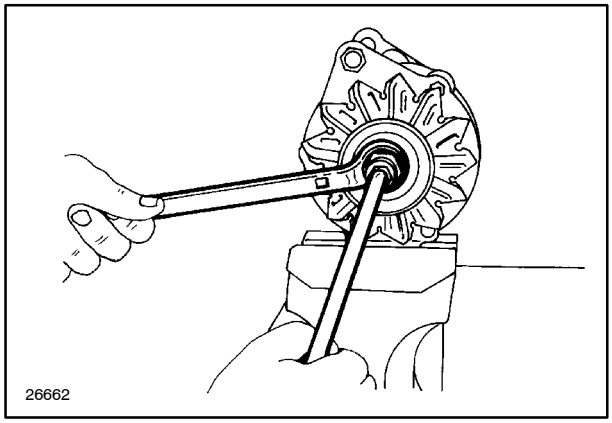
If the resistance reading is different from the prescribed value, or if it is infinite (interrupted circuit), check and replace the rotor if necessary (Fig. 23).



23

DISASSEMBLY

Fit a suitable Allen wrench in the hexagonal hole on the alternator shaft to prevent it from moving whilst, with another wrench, unscrew the fan and rotor pulley. Extract these parts, together with the spacers and alternator shaft washers (Fig. 24).

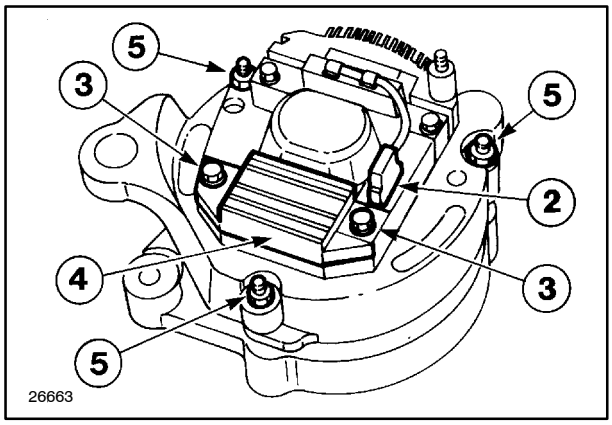


24

Disconnect the excitation diode terminal wire connector (2) from the pin connected to the positive brush.

Unscrew the screws (3) securing the electronic voltage regulator (4), complete with brushes, to the rear alternator support.

Unscrew the nuts (5) and extract the screws that fasten the alternator main external parts – (Fig. 25).

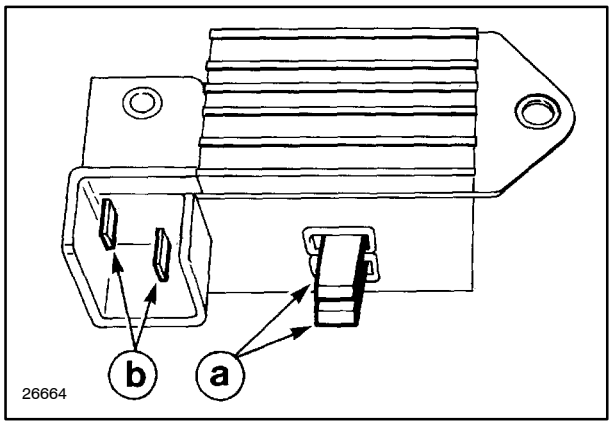


25

ELECTRONIC VOLTAGE REGULATOR (Fig. 26)

a. Brushes

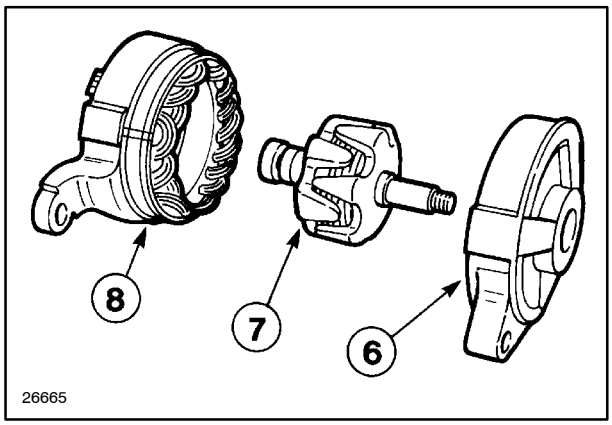
b. Plate pins



26

Separate the parts (as illustrated) bearing in mind that a considerable degree of pressure on the rotor shaft is required to free the front support plate (6) and the rotor (7) (Fig. 27).

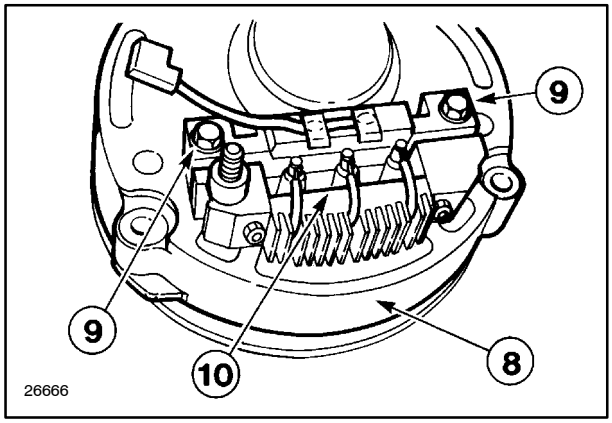
If a press is not available, use a brass striker to avoid damaging the thread.



27

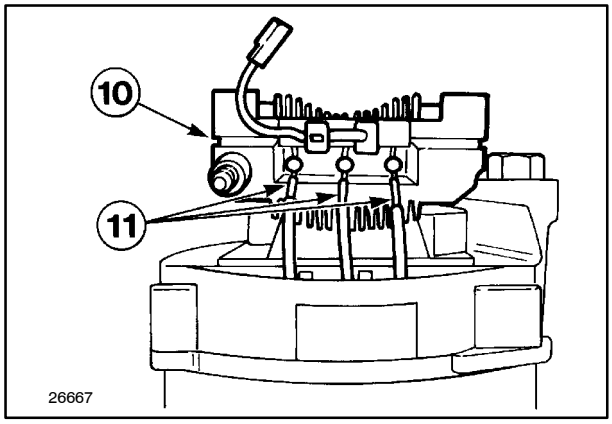
Unscrew the screws (9) securing the rectifier bridge (10) to the rear support plate (8) (Fig. 28).

The rectifier bridge must not be disassembled, as the spare part is provided complete.



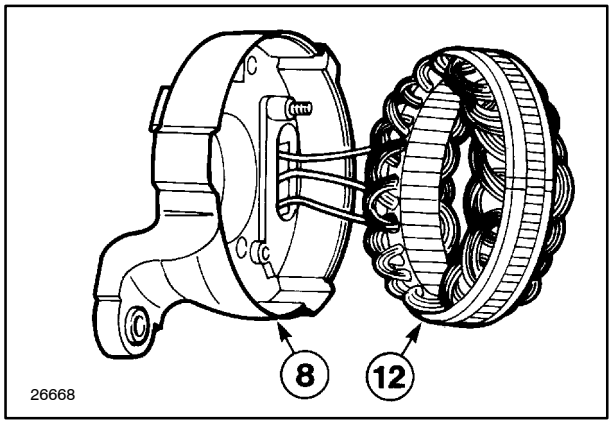
28

Separate the rectifier bridge (10) from the rear support plate and unweld the stator winding terminals (11) (Fig. 29).



29

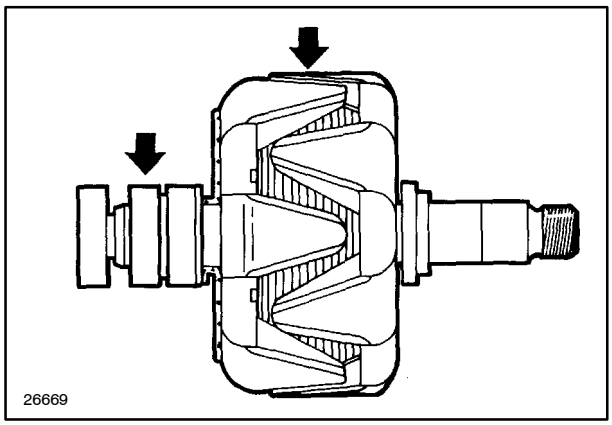
Separate the stator (12) and the terminals (11) from the rear support plate (8) (Fig. 30).



30

INDUCTOR WINDING INSULATION TEST

Place both points of an ohmmeter (regulated on a Ω x 1 scale) in contact respectively with a slip ring and the rotor casing (see arrows). The instrument should show infinite resistance. If this is not the case, replace the rotor (Fig. 31).

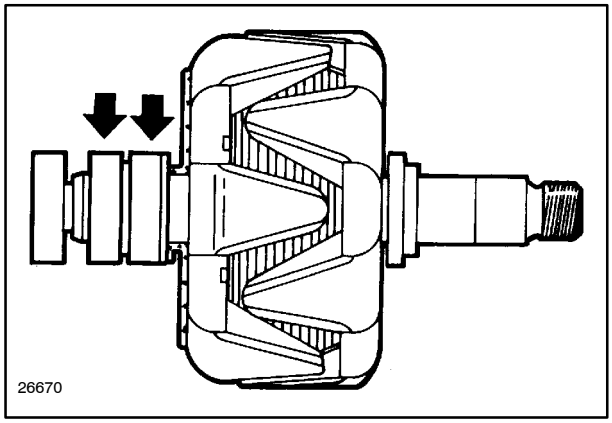


31

Check on inductor (rotor) resistance on slip rings

Place both points of an ohmmeter (regulated on a Ω x 1 scale) in contact respectively with the rotor slip rings (see arrows): the instrument should show a certain degree of resistance (Fig. 32).

If the resistance reading is different from the prescribed value, or if it is infinite (interrupted circuit), replace the rotor.



32

Check that the bearing rotates freely, without sticking or making noise.

Check that the brushes have not dented the rings. If this is the case, replace the whole rotor.

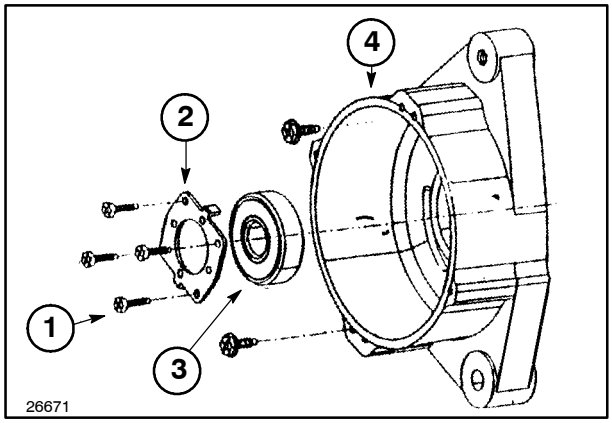
Assembly

To assemble, reverse the order of the disassembly operations.

OVERHAUL

1. Check that the rotor and stator poles are not worn. If this is the case, either the bearings are worn, the boxes are not aligned or the rotor shaft is deformed.

NOTE: *The alternator bearings cannot be serviced separately, therefore they must both be changed when necessary.*

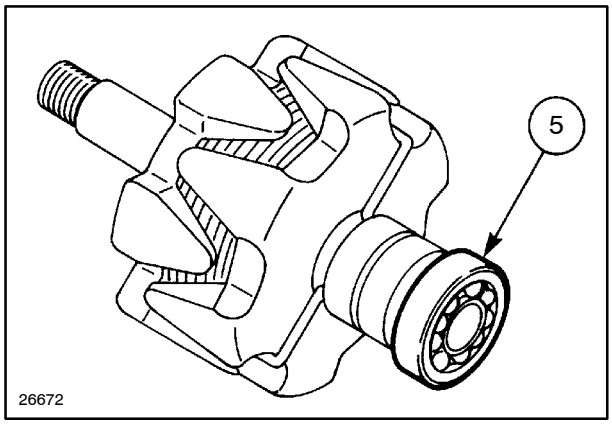


33

2. Remove the bearing lock (3) plate (2) securing screws (1) then remove the front support plate (4) (Fig. 33). Check for wear and damage and replace, if necessary.

   Before installing the ball bearing, check the front support plate holder and clean it carefully.

3. Installation of bearing (5) on the support plate side is different from the previous operation. A new rotor and bearing assembly must be fitted (Fig. 34).



34

INSTALLATION

1. Refit the alternator by following the removal procedure in reverse order.

During installation, remember to:

- make sure that the negative (ground) battery cable is disconnected from the battery during alternator installation.
- regulate the alternator driving belt as previously described in this chapter.

SECTION 55 - ELECTRICAL SYSTEM

Chapter 5 - BATTERY
(version from frame no. 1266941 for models with cab, from frame no. 1268756 for models with platform)

CONTENTS

Section	Description	Page
55 000	Technical data	1
	Description and operation	1
	Removal-Installation	2
	Battery checking and maintenance	4
	Tests	6

55 000 TECHNICAL DATA

CHARACTERISTICS	TYPE OF BATTERY	
	Model 70Hp 80Hp	Model 90Hp 100Hp
Voltage (V)	12	
Cold start amperage (C.C.A)	1x800	1x960
Capacity (Ah)	100	132
Number of elements	6	
Number of plates on each element	16	21
Reserve capacity (SAE) (minimum)	160	210
Weight lbs. (kg)	55.11 (25)	77.16 (35)
Grounding terminal	Negative	

DESCRIPTION AND OPERATION

Both types of batteries are "sealed and maintenance-free".

The 100 Ah battery, installed on the 70Hp-80Hp models, is fitted in front of the radiator, inside the front axle support.

The 132 Ah battery is fitted on 90Hp-100Hp models, provided with cab air-conditioning system, installed on top of the front axle support.

NOTE: *"Maintenance-free" means that the battery does not leak electrolyte in normal conditions of use. Leaks may occur if the battery is charged over 14.4 V. This causes the liquid to boil as a result of the gas formed whilst the battery is fully charging. This event may be caused by a charging system fault, quick recharging or topping up.*

The four main functions of a battery are:

- To supply a source of electric energy for starting, switching on and running the instruments.
- Controlling the electrical system voltage.
- To supply electricity when the power required is higher than that produced by the alternator.
- To support inactive loads from the radio and the microprocessor memory.

Each element of the battery consists of positive and negative plates, positioned alternatively one next to the other. Each positive plate is separated from the negative plate by means of a porous insulating separator. If one of the positive plates comes into contact with the negative plates in the element, the element will short circuit and be irreparably damaged. All of the positive plates are welded to a bar and form a positive terminal, whereas all of the negative plates are welded to a similar bar and form a negative terminal.

Each positive plate comprises a lead grid with lead peroxide pasted to the grid holes. The negative plates consist of a lead grid with lead sponge pasted to the grid holes.

The plates are covered by electrolyte formed by a diluted sulphuric acid solution.

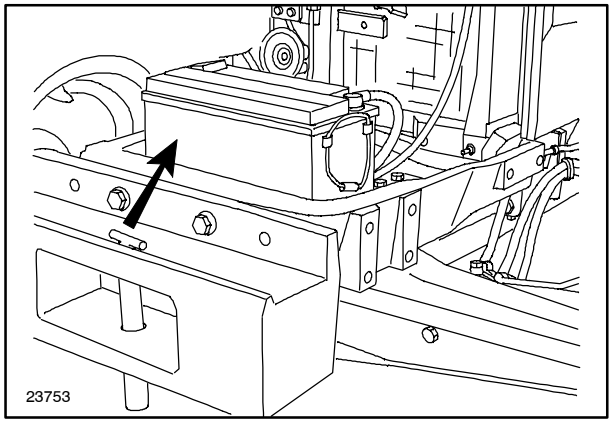
The battery casing is made in polypropylene.

REMOVAL AND INSTALLATION

REMOVAL

100 Ah capacity battery (Fig. 1)

Located inside the front axle support.



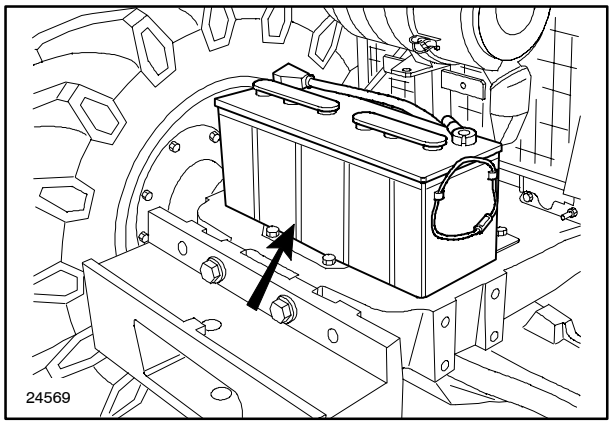
1

132 Ah capacity battery (Fig. 2)

Located on top of the front axle support.

To access the battery (on both versions), proceed as follows:

1. Raise engine cover.
2. 1. Disconnect the negative lead from the tractor frame and secure out of the way.
3. 2. Loosen the bolts on both terminals and disconnect the negative and positive cables from the battery, making sure that they do not touch the battery.
4. 3. Using the handles, fitted on both ends of the battery, lift and remove the battery from its housing.



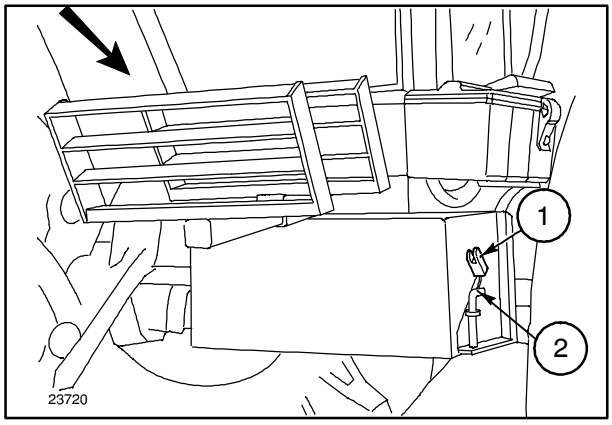
2

Battery located under platform (for certain versions) (Fig. 3)

Located under the platform, on the right hand side.

To access the battery, proceed as follows:

1. Raise the steps and lock in position with the pin.
2. Release the retention levers (1), on both sides, and remove the protective cover (2).
3. Loosen the bolts on both terminals and disconnect the positive and negative cables from the battery.
4. Using the handles, fitted on both ends of the battery, lift and remove the battery from its housing.



3

INSTALLATION

Applicable to all types of battery

1. To re-install the battery follow the removal procedure in reverse, with the following precautions:

- Make sure that the battery is clean and there are no traces of electrolyte leakage, also check that the breather covers are correctly installed. Spread petrolatum (e.g.: vaseline) on the terminals; do not use traditional grease lubricants, as these products may favour electrolytic corrosion.

- Make sure that the battery housing and support are clean without objects (small stones, etc.) which could pierce the battery casing.

- Make sure that the battery terminal polarity is correct and that the terminal connections are suitably (but not excessively) tightened.

- If a radio is installed, all data stored in the memory will be lost and it will need to be reprogrammed. Electronic control units and microprocessors - when installed - will not lose stored data, as electronic stress and transmission control calibration are not involved in this operation.

BATTERY CHECKING AND MAINTENANCE

RELATIVE DENSITY

The relative density of the battery electrolyte shows the charge level of the battery. When the battery is fully charged, the relative density of the electrolyte is at least 34.30 at 77 °F (1.280 at 25 °C).

Alternatively, the approximate charge status can be measured by using a digital voltmeter (± 0.01V) as follows:

Less than 10.5V Battery unusable*

Less than 11,8V Battery flat

Less than 12.3V Battery half-charged

More than 12.6V Battery fully-charged

* See the notes under the "TESTS" heading, for instructions on how to recuperate a slightly sulphated battery.

The battery voltage must be measured on a flat battery, considering the following:

A) After the battery has not been charged for at least 4 hours.

B) If the vehicle has been used recently, switch the headlamps on for two minutes.

When a battery is flat, the sulphuric acid in the electrolyte combines chemically with the plates and this decreases the relative density of the solution.

A battery densimeter will determine the relative density of the electrolyte in an element, and the quantity of sulphuric acid not used in the solution indicates the degree of charge of that element.

Low temperatures require a higher battery charge to operate. For example: a battery with a relative density of 34.20 at 80.6 °F (1.225 at 27 °C) can activate the starter motor at ambient temperatures, but will fail to do so if the temperature drops as a result of poor battery performance levels.

Table 1 shows the effect of temperature on battery performance.

Table 1

Temperature	Fully charged battery performance
77 °F (25.0 °C)	100%
23.9 °F (-4.5 °C)	82%
-11.2 °F (-24.0 °C)	64%
-17.5 °F (-27.5 °C)	58%
-23.8 °F (-31.0 °C)	50%
-30.1 °F (-34.5 °C)	40%
-35.5 °F (-37.5 °C)	33%

Maximum battery life can be achieved by taking care of and regularly checking the battery. The energy capacity output must not be exceeded by a constant/ excessive overload and charging requirements must be respected.

BATTERY MAINTENANCE

CAUTION

Batteries contain sulphuric acid and generate a highly explosive hydrogen and oxygen mix during charging.

- Never use devices that produce flames or sparks whilst checking the electrolyte level
- Always protect hands and eyes before removing the battery caps.

During battery maintenance, follow the steps below:

1. Keep the electrolyte at the recommended level of 0.6692 in. (17 mm) over the plates. If this level is not respected, the acid concentration will increase, which could cause damage to the separators and diminish plate performance.
2. Only use distilled or demineralized water, never overfill or use tap/rain water or other sources of water.
3. Keep the battery 75% charged (at least) to avoid plate sulphurisation, performance loss and possible freezing at low temperatures.
4. Avoid overcharging the battery, as excessive charge will generate high internal heat, causing grid deterioration water leaks.
5. During rapid recharging, make sure that the battery temperature does not exceed 122 °F (50 °C).

6. Do not add sulphuric acid to an element unless electrolyte has been spilled. Before topping up, make sure that the solution has the correct relative density. Slow recharge is the only way to recharge the battery completely. Use a high amperage battery charger to charge the battery with high current intensity for short periods of time, but this must be followed by a slow charge to achieve full capacity battery performance.

DRY-CHARGED BATTERIES

Dry charged batteries must be prepared as followed:

1. Remove the breather caps from the battery element.

2. Fill each element to the recommended level with electrolyte, at the relative density of 1.260.

NOTE: *The electrolyte is formed with sulphuric acid, diluted at a temperature of 69.8° to 89.6 °F (21° to 32 °C).*

3. After filling, leave the battery to rest for 15 minutes, then check the electrolyte level and top up if required.

4. Charge the battery for 4 hours at 5 to 8 A. making sure that all of the elements are freely producing gas.

5. Refit the breather caps on the battery element.

CHARGING THE BATTERY

Before charging a battery:

1. Thoroughly clean the battery casing, the covers on the elements and the terminals with diluted ammonia or warm water.

2. Check the level of the electrolyte in each element and, if found to be under the plate level, top up with distilled water to cover the plates.

NORMAL CHARGING (TOP UP)

1. Fully charge the battery using a slow battery charger at 3 to 6 A. for the required time. This operation could take 36 hours or more if the battery is extremely flat. A severely sulphured battery may not charge at all. When the battery is completely charged, the elements will produce gas freely and the relative density will remain constant. Disconnect the battery charger after three consecutive densimeter readings taken each hour, to show that the relative density has stopped increasing.

2. When using a rapid or fast ampere charge, follow the manufacturer's instructions carefully. High charging amperage increases the electrolyte temperature and, if the battery charger is not fitted with an automatic timer or thermostat, this temperature may exceed 122 °F (50 °C), which can lead to violent boiling in the battery, thereby damaging the internal components.

3. Re-check the level of the electrolyte in each element and add distilled water as needed.

⚠ CAUTION ⚠

Explosive gas is formed when a battery is charged. Do not smoke or use naked flames when checking the electrolyte level and make sure that the battery charger is switched off before connecting or disconnecting, to avoid sparks that may ignite the gas.

CHARGING EXTREMELY FLAT BATTERIES

To recharge a Pb-Ca maintenance-free battery we recommend using a constant voltage battery charger. For extremely flat batteries, charge for 48 hours at 16 V, with current limitation (50A for 100Ah and 66A for 132Ah).

This method is self-regulating: high current is provided at the beginning (when the battery voltage is very low), whilst current decreases progressively when the battery is fully charged (and the voltage is high).

If only constant voltage battery chargers are available, we recommend using the voltage levels and times shown in Table 2. These figures refer to extremely flat batteries. If the battery is only 50% charged, use half the time shown (slow charging programs). For other conditions, reduce charging time proportionally. When feasible, use the slowest charging programme for increased battery life.

If violent boiling occurs during recharging, due to gas formation or electrolyte leakage (122 °F (50 °C) or more), temporarily reduce or stop battery charging to avoid damaging the battery.

Table 2

	Type of battery	
	100Ah (800 cca)	132Ah (960 cca)
Slow charging programs	25 hours at 5A 12.5 hours at 10A	30 hrs at 5A 15 hrs at 10A
Rapid charging programs (emergency use only)	7 hours at 10A	10 hrs at 18A

TESTS

Before beginning battery tests, check that the breathers are not blocked, there is no rust, the breather caps are not open and the casing is not cracked.

Equipment required for testing:

- Densimeter
- Battery starter tester (high amperage multi-tester)
- Thermometer
- Battery charger

Relative density: This test shows the charge level of the battery.

1. With the float in the vertical position, note the reading.
2. Adjust the densimeter reading for battery electrolyte temperature variations subtracting 4 points (relative density 0.004) for every 41.9 °F (5.5 °C) below the calibrated temperature of the densimeter and adding 4 points (relative density 0.004) for every 41.9 °F (5.5 °C) above this temperature.

The following examples have been calculated with a densimeter calibrated at 86 °F (30 °C).

Example 1:

Temperature lower than	86 °F (30 °C)
Electrolyte temperature	66.2 °F (19 °C)
Densimeter reading	1.270
Subtract $\frac{11.0}{5.5}$ x 0.004	
Correct relative density =	1.262

Example 2:

Temperature above	86 °F (30 °C)
Electrolyte temperature	104 °F (40 °C)
Densimeter reading	1.220
Add $\frac{10.0}{5.5}$ x 0.004	0.007
Correct relative density =	1.227

3. Use the following table to define the charge level.

Charging conditions	Correct relative density at 59 °F (15 °C)	Correct relative density at 77 °F (25 °C)	Average battery voltage
100%	1.295	1.287	12.66
75%	1.253	1.246	12.45
50%	1.217	1.210	12.30
25%	1.177	1.170	12.00
Flat	1.137	1.130	11.84

NOTE: *The relative density should not vary more than 0.025 points between cells.*

4. If the relative density is 1.280 or more, the battery is fully charged and in good working condition.
5. If the relative density is less than 1.280, charge the battery and check the charging system to determine the cause of the low charge.

NOTE: *If distilled water has been added recently, recharge the battery for a short time, otherwise the densimeter will not provide precise readings.*

If the battery has been charged under static conditions, a thicker electrolyte will accumulate at the bottom of the elements. The battery must be shaken at regular intervals in order to mix the electrolyte. This will improve the charging amperage and provide more precise densimeter readings during the tests.

Performance test

The performance test helps us to understand if the battery can adequately start the engine. Voltage readings show battery condition. Before carrying out the test, check that the electrolyte level is correct and the open circuit voltage is 12.5 V or more. The battery can be tested in the tractor or removed.

1. Switch the battery start tester current control to "OFF" (high amperage discharge tester). Calibrate the voltage selection switch to the rated battery voltage, or slightly higher. Connect the positive tester conductors to the positive terminal on the battery and the negative conductors to the negative battery terminal.

2. Turn the current control knob until the ammeter reading reaches half the cold start battery amperage and note the voltage reading.

- If the reading shows 9.6 V or more after 15 seconds, the battery has adequate power output and can be easily charged following the normal procedure.

- If the reading is below 9.6 V, the battery is not satisfactory for use and must be tested as described below.

WARNING

Do not leave high discharge on the battery for more than 15 seconds.

Test charge: This test is only for batteries that failed to pass the previously described performance test.

1. Connect the positive battery charger tester conductors (high amperage discharge tester) to the positive battery terminal and the negative conductors to the negative battery terminal.

2. Connect the positive battery charger conductor to the positive battery terminal and the negative conductor to the negative battery terminal.

3. Turn the battery charger timer to more than the "3 minute" charge, and then back to the "3 minute" charge.

4. Set the charging amperage as close as possible to 40 A.

5. After 3 minutes of rapid charging, read the voltmeter.

- If the total voltage exceeds 15.5 V, the battery is not satisfactory and is probably sulphured or worn and must be replaced.

NOTE: *A slightly sulphured battery can be renewed using a multiple-type battery charger, with an upper open circuit voltage limit of 50 V.*

A sulphated battery has high resistance and for this reason it will be necessary to set a high voltage at the beginning to overcome resistance.

At the beginning there may be no visible sign of charging.

After a few minutes of inactivity a low charge will be shown, followed by a rapid amperage rise.

Amperage must not exceed 14.0 A or the temperature of the electrolyte must not exceed 122 °F (50 °C).

When the amperage has stabilized, reset the volts so the amperage is fixed on 5 A.

Continue with this amperage until the relative density of the electrolyte stops increasing at approx. 1.275 to 1.280 at 68 °F (20 °C); This may take 48 hours. Let the battery rest for 24 hours and then carry out the previously described performance test.

- If the total voltage is below 15.5 V, check the relative density of each element and recharge the battery according to the following scale:

Relative density	Rapid charge up to:
1.150 or less	60 minutes
from 1.151 to 1.175	45 minutes
from 1.176 to 1.200	30 minutes
from 1.200 to 1.225	15 minutes (Only slow charge)

NOTE: *When there are battery problems, the fan belt tension and the entire charging system must be checked.*

BATTERY PROBLEMS - FREQUENT CAUSES

1. Internal open circuit.

2. Internal short.

3. Battery electrolyte leakage.

4. Grid active material separation.

5. Accumulation of sulphate crystals too big to be dispersed.

These faults are normally caused by:

1. Component failure inside the element.

2. Excessive crystal growth leading to perforated separators and possibly short circuits.

3. Excessive overload (inefficient charging system, high voltage rapid charging, operation at high temperatures).

4. Battery electrolyte freezing.

   A fully charged battery freezes at -85 °F (-65 °C). A 50% charged battery freezes between 1.4 °F (-17 °C) and -16.6 °F (-27 °C). Completely flat electrolyte freezes at 26.6 °F (-3 °C) to 12.2 °F (-11 °C). Excessively fast charging and boiling caused by gas formation cause the separation of active material from the grids. Separation destroys the battery chemical function.

5. Crystals are formed when batteries are left flat. High temperatures and long periods in this condition accentuate the problem. If a battery is left at ambient temperature for a week, it will be difficult to recharge on the tractor. Recharging will require a higher constant voltage. After 3 weeks, the battery will be permanently damaged and it will be necessary to follow the procedure described for “extremely flat batteries”.

Fully charged batteries last for longer. A lead-calcium battery discharges 3% every month. This means that in 16 months the charge will drop by 50%. The inactive load on the tractor is approx. 50 mA. An approximate discharge on an unused vehicle is valued at 8 Ah per week.

It is worth noting that if a battery is weak during engine starting, it is best to let the battery rest for a couple of minutes. This rest time should increase as the temperature decreases.

SECTION 55 - ELECTRICAL SYSTEM

Chapter 6 - ELECTRICAL CIRCUITS
(version from frame no. 1266941 for models with cab, from frame no. 1268756 for models with platform)

CONTENTS

Section	Description	Page
55 100	Electrical circuit components	3
	Location of fuses and relays (Version with cab)	7
	Location of fuses and relays (Version without cab - NASO)	11
	Location of fuses and relays (Version without cab - ISO)	13
	Maxi fuse box	15
	Power sockets	16
	Operator safety circuit	17
	Ground location points	18
	Symbols used in electrical circuits	20
	Electrical circuits	22
	Wiring DIAGRAM A	23
	Starting and recharging circuit - DIAGRAM A	25
	Wiring DIAGRAM A/1	31
	Operator safety circuit - DIAGRAM A/1	33
	Wiring DIAGRAM B	39
	Side lights, full beam, dipped beam, number plate and instrument lighting circuit (Version with cab) - DIAGRAM B	41
	Wiring DIAGRAMS C - D	49
	Side lights, full beam, dipped beam, number plate and instrument lighting circuit (Version without cab - ISO) - DIAGRAM C	51
	Side lights, full beam, dipped beam, number plate and instrument lighting (Version without cab - NASO) - DIAGRAM D	59
	Wiring DIAGRAM E	65
	Direction indicator and hazard lights circuit (version with cab - NASO) - DIAGRAM E	67
	Wiring DIAGRAMS F - G	75
	Direction indicator and hazard lights circuit (version without cab - NASO) - DIAGRAM F	77
	Direction indicator and hazard lights circuit (version without cab - ISO) - DIAGRAM	83

Wiring DIAGRAMS H - I - L 89

Work lights, rotating beacon circuit - DIAGRAM H 91

Cab ventilation and air-conditioning system, radio and internal lighting circuit - DIAGRAM I 99

Windscreen wiper/washer, rear windscreen wiper/washer and cigar lighter circuit - DIAGRAM L 105

Wiring DIAGRAMS M - N - O 109

Differential lock and brake lights circuit (Version with Power Shuttle) - DIAGRAM M 111

4WD, trailer brake, PTO circuit (Version with Power Shuttle) - DIAGRAM N 121

Transmission circuit (Version with Power Shuttle) - DIAGRAM O 129

Wiring DIAGRAMS P - Q - R/1 - R/2 137

Differential lock and brake lights circuit [Version with Dual Command (2 Speed Power Shift)] - DIAGRAM P 139

4WD, trailer brake, PTO circuit [Version with Dual Command (2 Speed Power Shift)] - DIAGRAM Q 147

Transmission circuit [Version with Dual Command (2 Speed Power Shift)] - DIAGRAM R/1 153

Transmission circuit [Version with Dual Command (2 Speed Power Shift)] - DIAGRAM R/2 159

Wiring DIAGRAMS S - T 163

Differential lock and brake lights circuit (version without cab - ISO) - DIAGRAM S . . . 165

Differential lock and brake lights circuit (version without cab - NASO) - DIAGRAM T . 171

Wiring DIAGRAMS U/1 - U/2 177

Power Shuttle circuit - DIAGRAM U/1 179

Power Shuttle circuit - DIAGRAM U/2 189

Wiring DIAGRAM V 197

Electronic lift circuit (Model Bosch) - DIAGRAM V 199

Wiring DIAGRAMS Z - X 205

Dual Command (2 Speed Power Shift) circuit - DIAGRAM Z 207

Power sockets, seven-pole coupling (ISO - NASO) and seat circuit - DIAGRAM X . . 213

Wiring DIAGRAMS Y - K 219

Horn, sensors and transmitters circuit - DIAGRAM Y 221

Digital instrument, digital clock circuit - DIAGRAM K 229

Power Shuttle electronic control unit input/output circuit (24 + 24) - DIAGRAM W 233

ELECTRICAL CIRCUIT COMPONENTS

1	Battery
2	Engine coolant temperature sensor
3	Engine ground
4	Sediment filter sensor
6	Front LH headlamp
7	Front RH headlamp
8	Acoustic signal
9	Air conditioning system compressor
10	Engine cut-out electromagnet
12	Air filter clogged sensor
13	Thermostarter
14	Front lights connection
15	Fuses and relay control unit
16	Brake lights switches
17	Connection for RH front direction indicator and side light
18	Brake fluid level sensor
19	Dual Command (2 Speed Power Shift) control switch
20	Control panel ground
21	Cab RH side ground
22	Control panel
23	Electrohydraulic PTO switch
25	Parking brake switch
26	RH front auxiliary work light
27	Cigar lighter
28	Rear windscreen wiper/washer switch
29	Rotating beacon control switch
30	Digital instrument
31	Radio connections
32	Cab RH upper side ground
33	RH speaker
34	Air-conditioner push-button
35	Ventilation and air-conditioning system connection
36	RH rotating beacon power socket
37	Windscreen wiper motor
38	Ventilation and air-conditioning system electric fan switch
39	Connection for auxiliary work light and RH rear extra direction indicator
40	Auxiliary power socket (internal)
41	RH number plate light (USA version)

ELECTRICAL CIRCUIT COMPONENTS (Continued)

42	LH speaker
43	Rear windscreen wiper motor
44	LH rotating beacon
45	LH front auxiliary work light
46	Cab overhead lighting
47	Connection for auxiliary work light and LH rear extra direction indicator
48	RH tail light
49	Left-hand side door switch
50	Front main connection (24 PIN)
51	4-pole socket 40 A (NASO)
53	Trailer brake solenoid valves
54	Safety pressure switches and trailer brake circuit indicator
55	Connection for LH front direction indicator and side light
56	Number plate light
57	LH tail light
58	Seven-pole power socket
59	Cab left-hand side ground
60	2-pole power socket 25A (ISO)
61	Main rear ground (transmission)
62	PTO speed sensor
63	Seat connection
64	Rear windscreen washer motor pump
65	Windscreen washer motor pump
66	Differential lock indicator switch
67	Fuel level transmitter
68	Forward speed sensor
69	Differential lock solenoid valve
70	4WD indicator pressure switch
71	Rear PTO solenoid valve
72	4WD solenoid valve
73	Dual Command (2 Speed Power Shift) solenoid valve
76	Dual Command (2 Speed Power Shift) reverser lever switch
77	Transmission side system connection (24 PIN)
79	Transmission side system connection (48 PIN)
81	Air-conditioner connection
82	Engine oil pressure sensor
83	Gearbox oil pressure switch
84	Starter motor

ELECTRICAL CIRCUIT COMPONENTS (Continued)

85	Over-voltage protection device
86	Over-voltage protection device ground
87	Alternator
88	Battery ground
89	External lights control switch
90	Thermostarter switch
91	Hazard lights switch
92	Work lights switch
93	Starter switch
94	Windscreen wiper/washer control
95	4WD switch
96	Differential lock switch
97	Seat safety switch
99	Safety circuit connection (8 PIN)
101	Alarm module
102	Ventilation and air-conditioning system electric fans
103	Electronic thermostat for air conditioner
104	Pressure switch for air conditioner
105	Front RH lower work light
106	Front LH lower work light
107	Diode (only for NASO version)
111	Electronic lift connection
112	Digital clock
114	Electronic lift control panel
115	Slip control switch
118	Sensors-control valve intermediate connection
119	RH draft sensor
120	LH draft sensor
121	Lift RH external switch
122	Lift LH external switch
123	Radar
124	Lift electronic control unit
125	Electronic flasher
126	Clutch pedal switch
127	Lift status switch
128	Cab RH upright light
129	Clutch pedal sensor
130	Power Shuttle control lever
131	Connection for 7-pole connection

ELECTRICAL CIRCUIT COMPONENTS (Continued)

132	Safety pressure switch A
133	Safety pressure switch B
134	Clutch A solenoid valve
135	Clutch B solenoid valve
136	Clutch C solenoid valve
137	Clutch D solenoid valve
138	Transmission oil temperature sensor
139	Gear lever position sensor
140	R1 range lever position sensor
141	R2 range lever position sensor
142	Power Shuttle control unit speed sensor
143	Lift raise solenoid valve
144	Lift lower solenoid valve
145	Electronic lift position sensor
146	Maxi fuse box: 1) 40 A - Power socket 40 A 2) 40 A - Power supply for fuses 3-4-7-8-9-10-11 3) 50 A - Power supply 1-2-12-13-14-15-16-17-18-20-21-22-23-24 and starter circuit 4) 40 A - Power supply for fuses 5-6-19 and work lights circuit
147	Handbrake status switch
148	Power Shuttle control unit
149	Power Shuttle circuit diagnosis connection
150	Cigar lighter on cab right-hand upright
151	Rear PTO switch
152	Rear work light (version without cab)
153	LH two-faced headlight (NASO version)
154	RH two-faced headlight (NASO version)

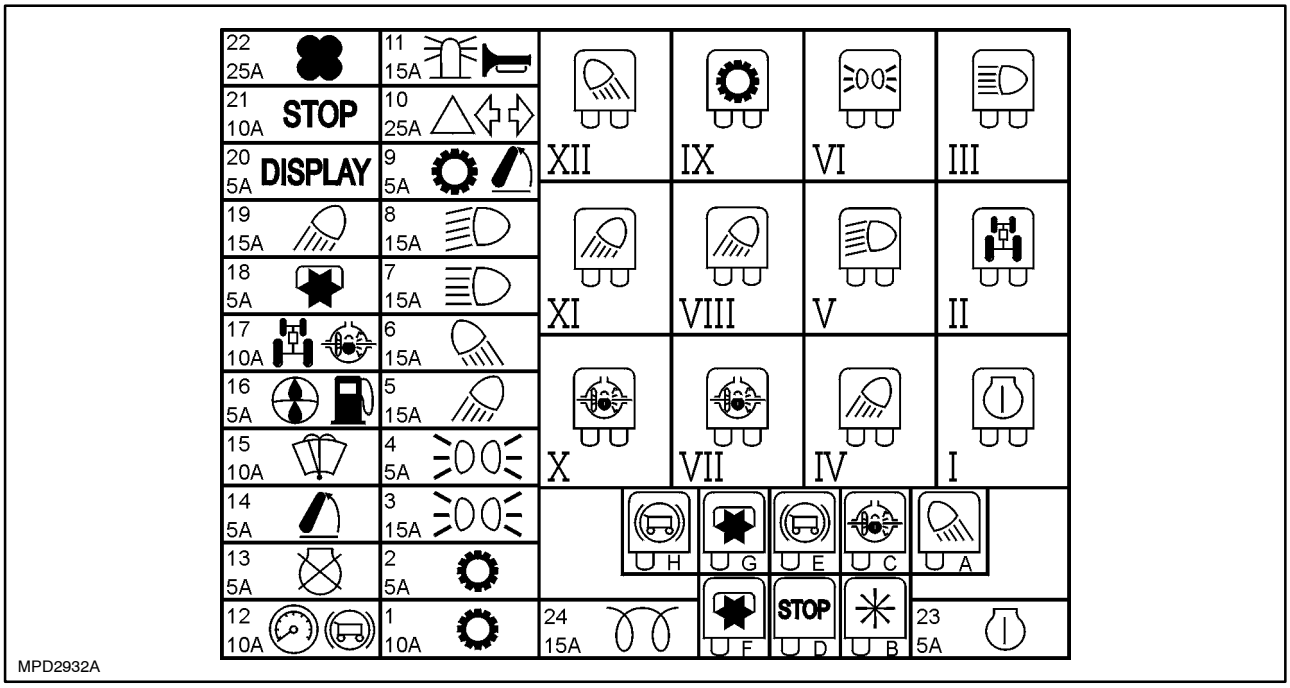
FUSES AND RELAYS (Version with cab)

DANGER

If electrical system relays need to be changed, check that correct spare parts are used and that they are fitted in the correct positions. The use of structurally or functionally different relays - even if interchangeable - could seriously compromise tractor control with dangerous results.

FUSES AND RELAYS MAIN FUSEBOX

The fuses and relays main fusebox (1, fig. 2) is located inside the dashboard, on the right-hand side, and can be accessed by removing the side panel (1, fig. 3) using the two knobs (2, fig. 3).



1

Relay functions

I. Engine starter circuit.

II. Electrohydraulic 4WD circuit.

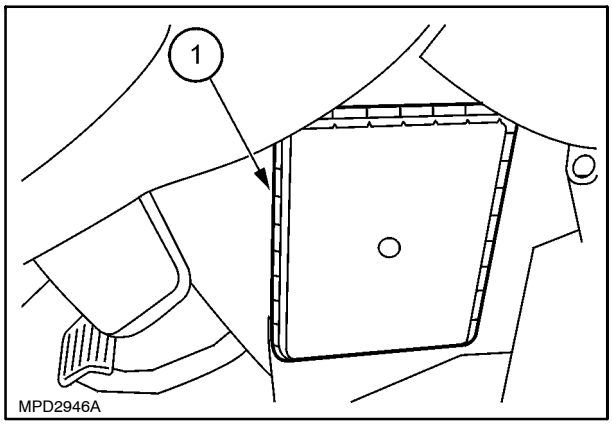
III. Full beam lights circuit.

IV. Not used.

V. Dipped beam lights circuit.

VI. Side lights circuit.

VII. Differential lock and brake lights circuit.



2

Fuse and relay main box location

VIII. Upper front work lights circuit.

IX. Not used (version with Power Shuttle) Dual Command (2 Speed Power Shift) circuit [version with Dual Command (2 Speed Power Shift)].

X. Differential lock circuit.

XI. Lower front work lights circuit

XII. Rear work lights circuit.

A. Not used.

B. Air conditioning circuit.

C. Differential lock circuit.

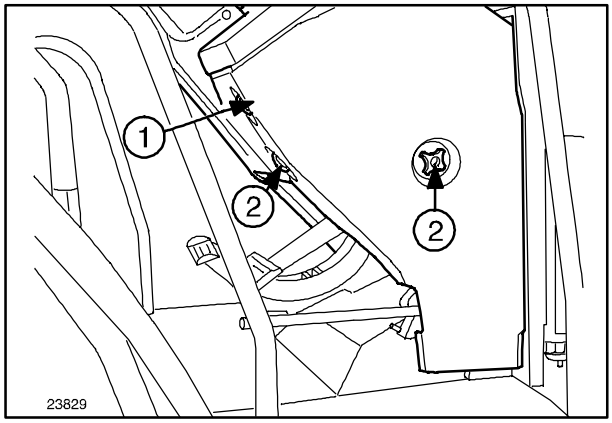
D. Brake lights circuit.

E. Trailer brake circuit.

F. Electrohydraulic PTO circuit.

G. Electrohydraulic PTO circuit.

H. Trailer brake circuit.



3

Main fusebox (version with Power Shuttle)

POWER SHUTTLE VERSION		
Valves	***Amps.***	***PROTECTED CIRCUITS***
1	10	Power Shuttle circuit.
2	5	Power Shuttle circuit.
3	15	Front right-hand and rear left-hand side lights, NASO 7-pole connector.
4	5	Front left-hand and rear left-hand side lights, controls and instruments lighting.
5	15	Lower front work lights.
6	15	Cab rear work lights.
7	15	Full beam headlights.
8	15	Dipped beam headlights.
9	5	Electronic lift circuit and Power Shuttle (+ Battery).
10	25	Direction indicators and hazard light.
11	15	Horn, 8A power socket, cigar lighter, rotating beacon, overhead lighting, radio.
12	10	Trailer brake circuit, instruments, seat safety circuit.
13	5	Engine cut-out electromagnet.
14	5	Electronic lift circuit, (+ key).
15	10	Front/rear windscreen wiper and window washers.
16	5	Sediment unit, compressor air-conditioner circuit.
17	10	4WD, differential lock circuit.
18	5	Rear power take-off circuit.
19	15	Upper front work lights.
20	5	Digital instrument circuit.
21	10	Brake lights, seat.
22	25	Fan unit, radio.
23	5	Starter safety circuit.
24	15	Thermostarter.

Main fusebox [version with Dual Command (2 Speed Power Shift)]

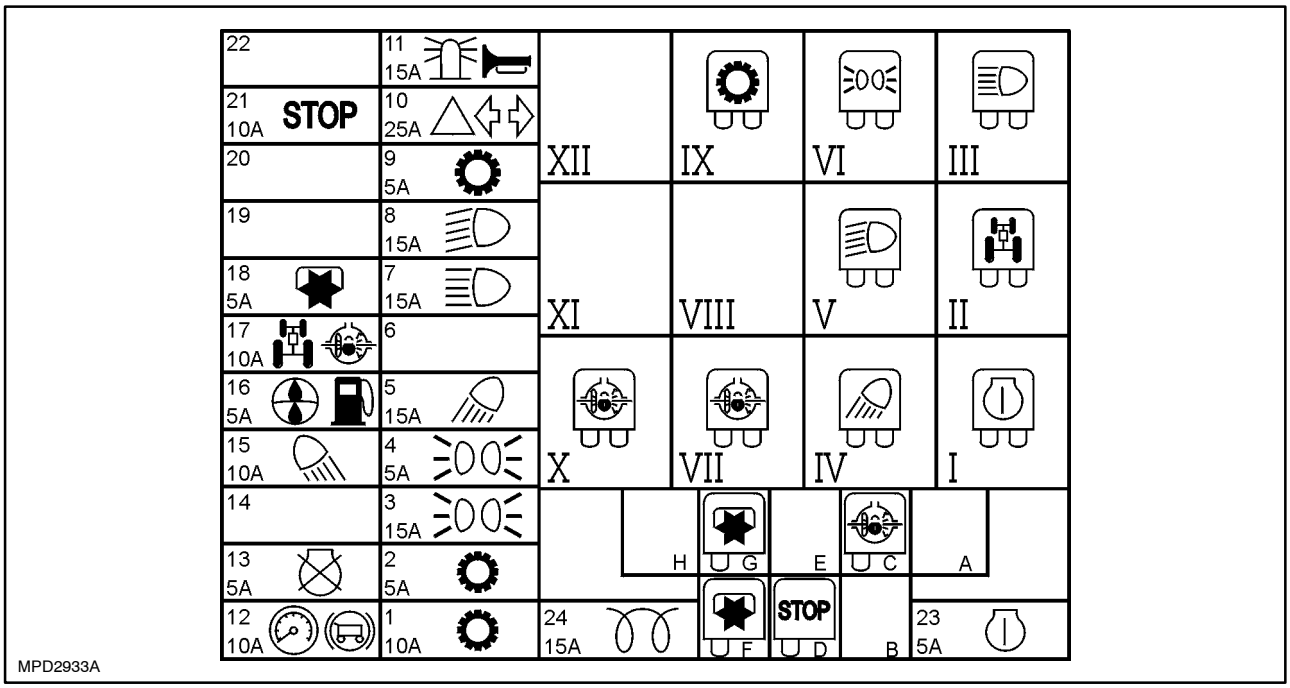
VERSION WITH DUAL COMMAND (2 SPEED POWER SHIFT)		
Valves	***Amps.***	***PROTECTED CIRCUITS***
1	-	Not used.
2	5	Dual Command (2 Speed Power Shift) circuit.
3	15	Front right-hand and rear left-hand side lights, NASO 7-pole connector.
4	5	Front left-hand and rear left-hand side lights, controls and instruments lighting.
5	15	Lower front work lights.
6	15	Cab rear work lights.
7	15	Full beam headlights.
8	15	Dipped beam headlights.
9	5	Electronic lift circuit.
10	25	Direction indicators and hazard light.
11	15	Horn, 8A power socket, cigar lighter, rotating beacon, overhead lighting, radio.
12	10	Trailer brake circuit, instruments, seat safety circuit.
13	5	Engine cut-out electromagnet.
14	5	Electronic lift circuit, (+ key).
15	10	Front/rear windscreen wiper and window washers.
16	5	Sediment unit, compressor air-conditioner circuit.
17	10	4WD, differential lock circuit.
18	5	Rear power take-off circuit.
19	15	Upper front work lights.
20	5	Digital instrument circuit.
21	10	Brake lights, seat.
22	25	Fan unit, radio.
23	5	Starter safety circuit.
24	15	Thermostarter.

LOCATION OF FUSES AND RELAYS (Version without cab)

DANGER

If electrical system relays need to be changed, check that correct spare parts are used and that they are fitted in the correct positions. The use of structurally or functionally different relays - even if interchangeable - could seriously compromise tractor control with dangerous results.

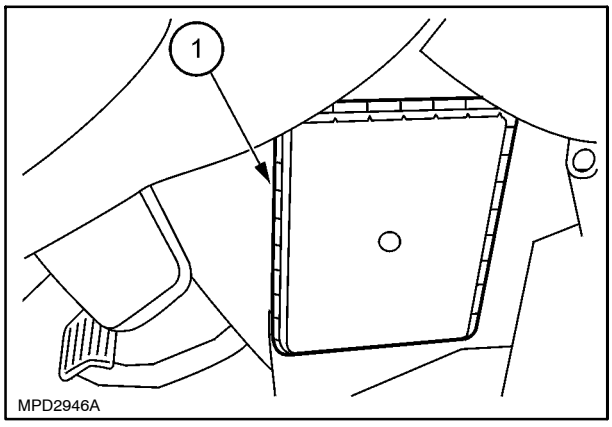
FUSES AND RELAYS MAIN FUSEBOX (NASO version)



4

Relay functions (NASO version)

I. Engine starter circuit.
II. Electrohydraulic 4WD circuit.
III. Full beam lights circuit.
IV. Front grille work lights.
V. Dipped beam lights circuit.
VI. Side lights circuit.
VII. Differential lock and brake lights circuit.
VIII. Not used.
IX. Not used.
X. Differential lock circuit.
XI. Not used.
XII. Not used
A. Not used.
B. Not used.
C. Differential lock circuit.
D. Brake lights circuit.
E. Not used.
F. Rear PTO circuit (only Electrohydraulic PTO).
G. Rear PTO circuit (only Electrohydraulic PTO).
H. Not used.



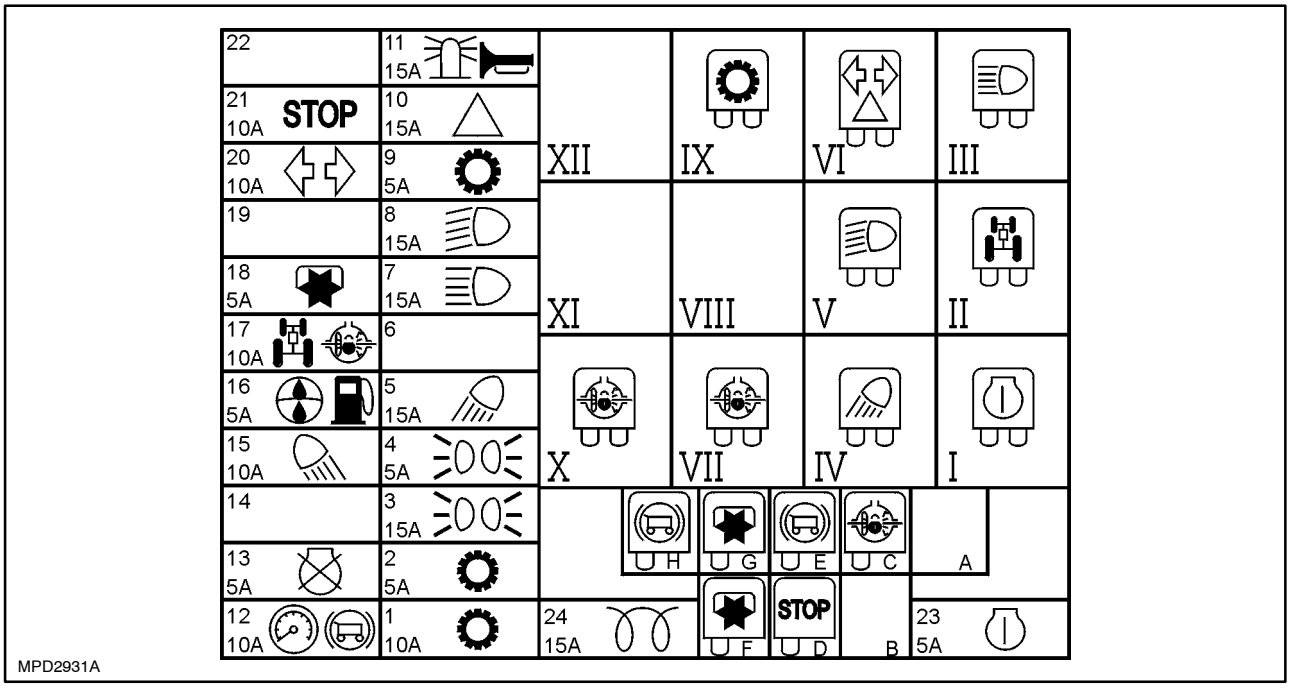
5

Fuse and relay main box location

Main fusebox (version without cab)

NASO VERSION		
Valves	***Amps.***	***PROTECTED CIRCUITS***
1	10	Power Shuttle circuit (+ key).
2	5	Dual Command (2 Speed Power Shift)/Power Shuttle circuit (+ key).
3	15	Front right-hand and rear left-hand side lights, 7-pole connector.
4	5	Front left-hand and rear left-hand side lights, controls and instruments lighting.
5	15	Grille front work lights.
6	-	Not used.
7	15	Full beam headlights.
8	15	Dipped beam headlights.
9	5	Power Shuttle circuit (+ Battery).
10	25	Direction indicators and hazard light.
11	15	Horn, 8A power socket, buzzer, side lights.
12	10	Instruments, seat safety circuit.
13	5	Engine cut-out electromagnet.
14	-	Not used.
15	10	Rear work light.
16	5	Sedimentation filter circuit.
17	10	4WD, differential lock circuit.
18	5	Rear power take-off circuit.
19	-	Not used.
20	-	Not used.
21	10	Brake lights.
22	-	Not used.
23	5	Starter safety circuit.
24	15	Thermostarter.

FUSES AND RELAYS MAIN FUSEBOX (ISO version)



6

Relay functions (ISO version)

I. Engine starter circuit.

II. Electrohydraulic 4WD circuit.

III. Full beam lights circuit.

IV. Not used.

V. Dipped beam lights circuit.

VI. Electronic flashing light.

VII. Differential lock and brake lights circuit.

VIII. Not used.

IX. Not used.

X. Differential lock circuit.

XI. Not used.

XII. Not used.

A. Not used.

B. Not used.

C. Differential lock circuit.

D. Brake lights circuit.

E. Trailer brake circuit.

F./G. Rear PTO circuit (only Electrohydraulic PTO).

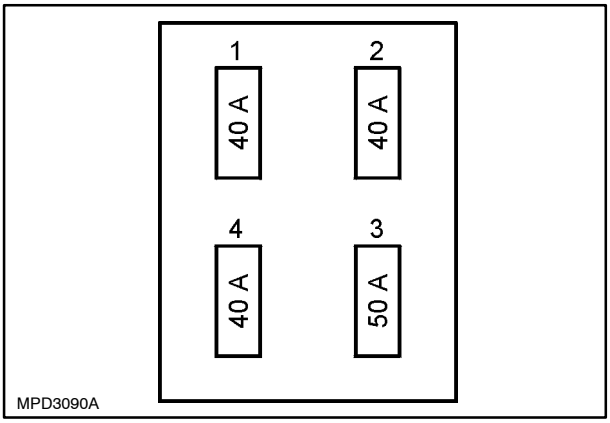
H. Trailer brake circuit.

Main fusebox (version without cab)

ISO VERSION		
Valves	***Amps.***	***PROTECTED CIRCUITS***
1	10	Power Shuttle circuit (+ key).
2	5	Power Shuttle circuit (+ key).
3	5	Front right-hand and rear left-hand side lights, side lights panel indicator.
4	5	Front left-hand and rear left-hand side lights, controls and instruments.
5	15	Lower work lights.
6	-	Not used.
7	15	Full beam headlights.
8	15	Dipped beam headlights.
9	5	Power Shuttle circuit (+ Battery).
10	15	Direction indicators and hazard light.
11	15	Horn, 8A power socket, buzzer.
12	10	Trailer brake circuit, instruments, operator alarm circuit.
13	5	Engine cut-out electromagnet.
14	-	Not used.
15	10	Rear work light.
16	5	Sediment unit circuit.
17	10	4WD, differential lock circuit.
18	5	Rear power take-off circuit.
19	-	Not used.
20	10	Direction indicators.
21	10	Brake lights.
22	-	Not used.
23	5	Starter safety circuit.
24	15	Thermostarter.

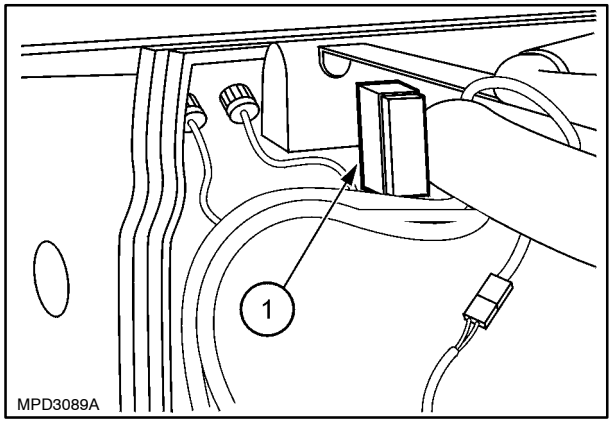
MAXI FUSE BOX

The Maxi Fuse box (1, fig. 8) is located inside the engine compartment, on the right-hand side near the brake fluid reservoir.



7

Maxi fuse layout



8

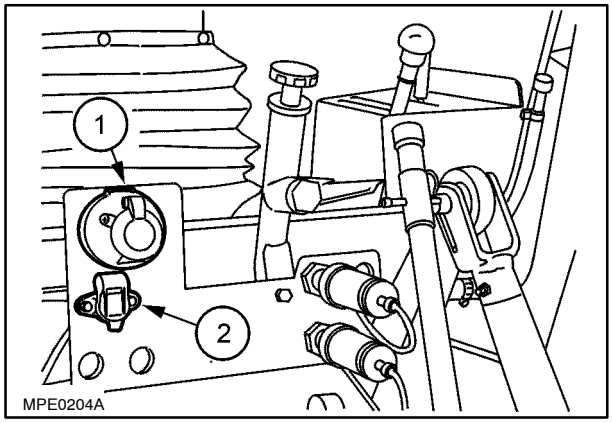
Location of Maxi Fuse box

Valves	*Amps.*	*PROTECTED CIRCUITS*
1	40	40 A power socket.
2	40	Fuse power supply Nos. 3 - 4- 7 - 8- 9- 10- 11.
3	50	Fuse power supply Nos. 1 - 2 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 20 - 21 - 22 - 23 - 24 and starter circuit.
4	40	Fuse power supply Nos. 5 - 6 - 19 (work lights).

POWER SOCKETS (Fig. 9)

The power sockets are located on the rear of the tractor, on the left-hand side.

1. Seven-pole socket.
2. 25 A two-pole power socket (ISO)
   40 A four-pole power socket (NASO).



9

Seven-pole power socket (Fig. 10)

The PTO contacts carry out the following functions:

1 - L. Left-hand side direction indicators.

2 - 54G. Not used.

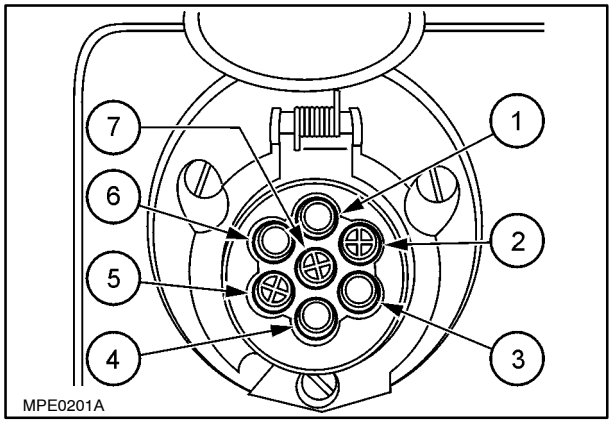
3 - 31. Ground.

4 - R. Right-hand side direction indicators.

5 - 58R. Right-hand side lights.

6 - 54. Brake lights.

7 - 58L. Left-hand side lights.



10

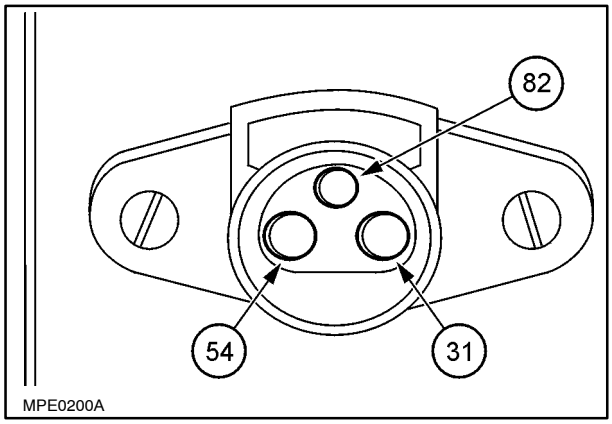
25 A two-pole power socket (ISO version) (Fig. 11)

Located under the seven-pole power socket and provided with two positive terminals and one ground, with the following positions:

82. Key-controlled power.

54. Direct power.

31. Ground.



11

40 A power socket (NASO version) (Fig. 12)

Provides the following positions:

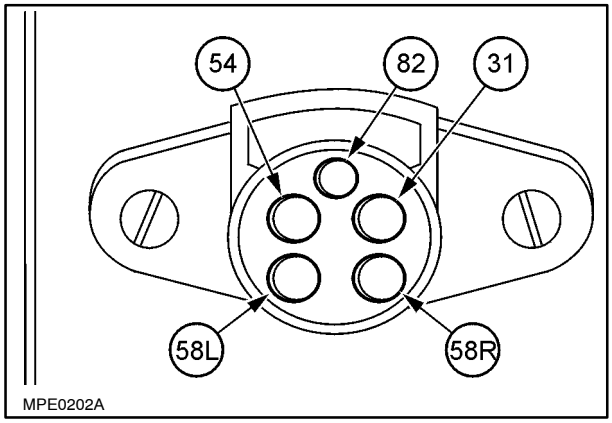
82. Key-controlled power.

54. Direct power.

31. Ground.

58L. Ground.

58R. Direct power.



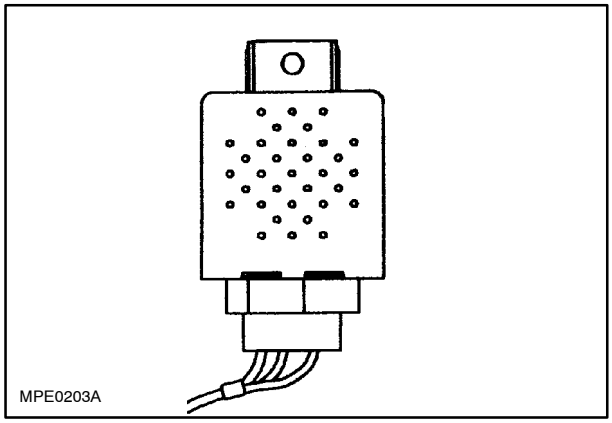
12

OPERATOR SAFETY CIRCUIT (Fig. 13)

DESCRIPTION

The circuit is composed of an alarm module with acoustic warning connected to the handbrake, the sensor under the driver's seat and the rear PTO switch.

The alarm module is located inside the dashboard.



13

OPERATION

The circuit operates in three ways:

1. With the engine running and no one seated in the driving position, with the handbrake disengaged and the PTO ON, the alarm is activated.
2. With the engine running and the driving position occupied, the alarm is always deactivated.
3. With the engine switched off and the driving position free/occupied, with the handbrake disengaged and the PTO ON or OFF, the alarm is activated.

GROUND LOCATION POINTS

A. Instrument panel ground.

B. Battery ground.

C. Engine compartment ground.

D. Cab RH upper side ground.

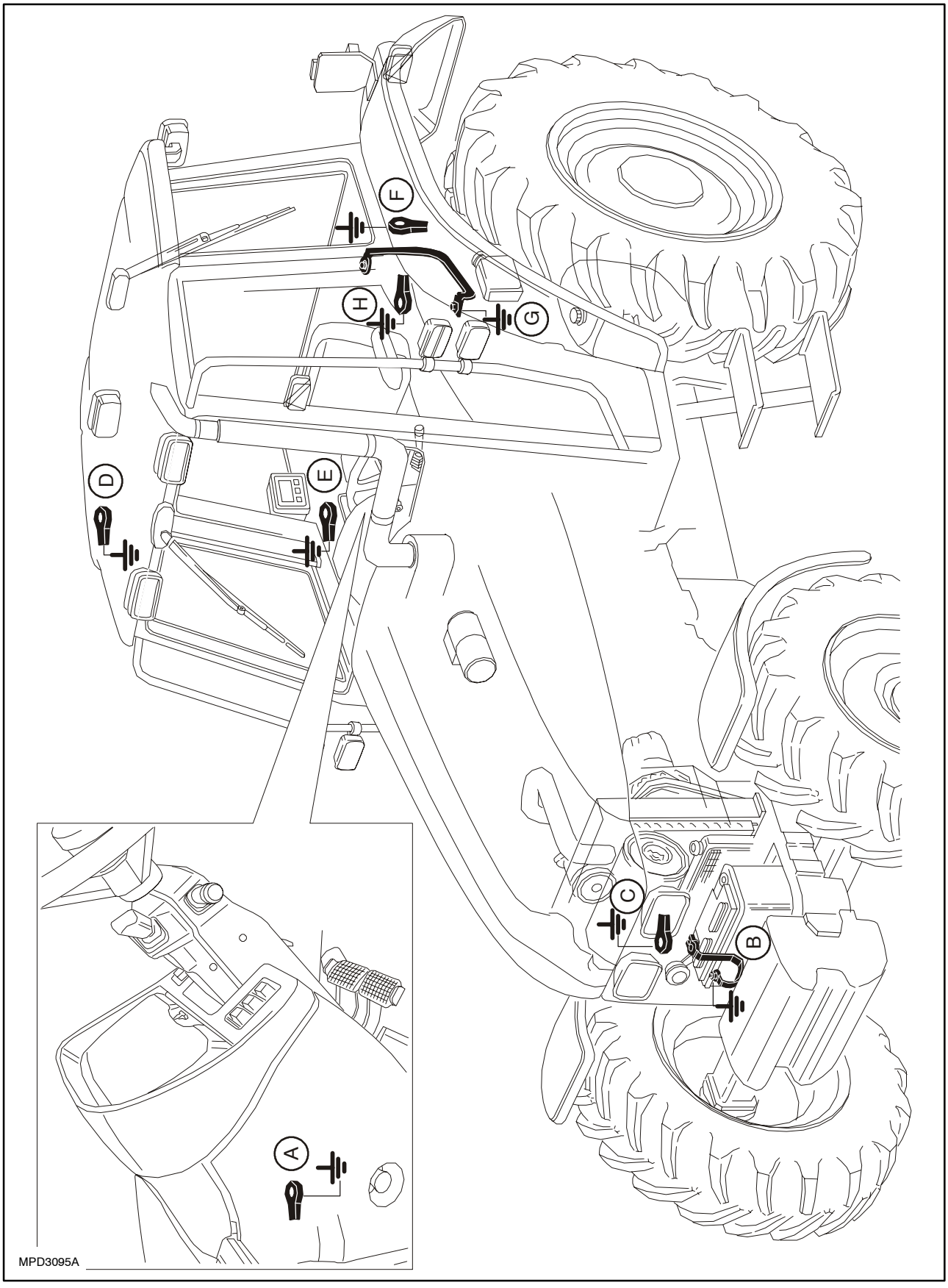
E. Cab RH side ground.

F. Main rear ground (transmission).

G. Cab frame/body connecting ground.

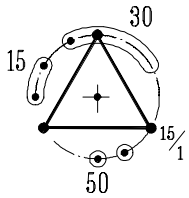
H. Cab LH side ground.

GROUND POINTS LAYOUT



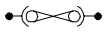
14

SYMBOLS USED IN ELECTRICAL CIRCUITS



Starter switch

Battery



Fuse

Motor

Lights
and warning indicators

Switch relay

Switch relay

Pressure switch/Sensor

Indicator switch

Speaker

Diode

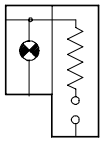
Connection

Connection

Thermostarter

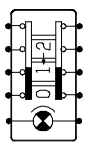
Horn

Variable resistor



Cigar lighter

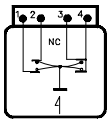
Power socket



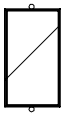
Control switch

MPD2703A

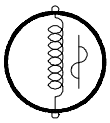
SYMBOLS USED IN ELECTRICAL CIRCUITS (continued)



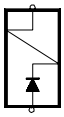
Switch



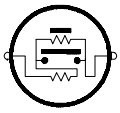
Solenoid Valve



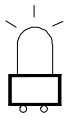
Inductive sensor



Solenoid Valve



Sensor



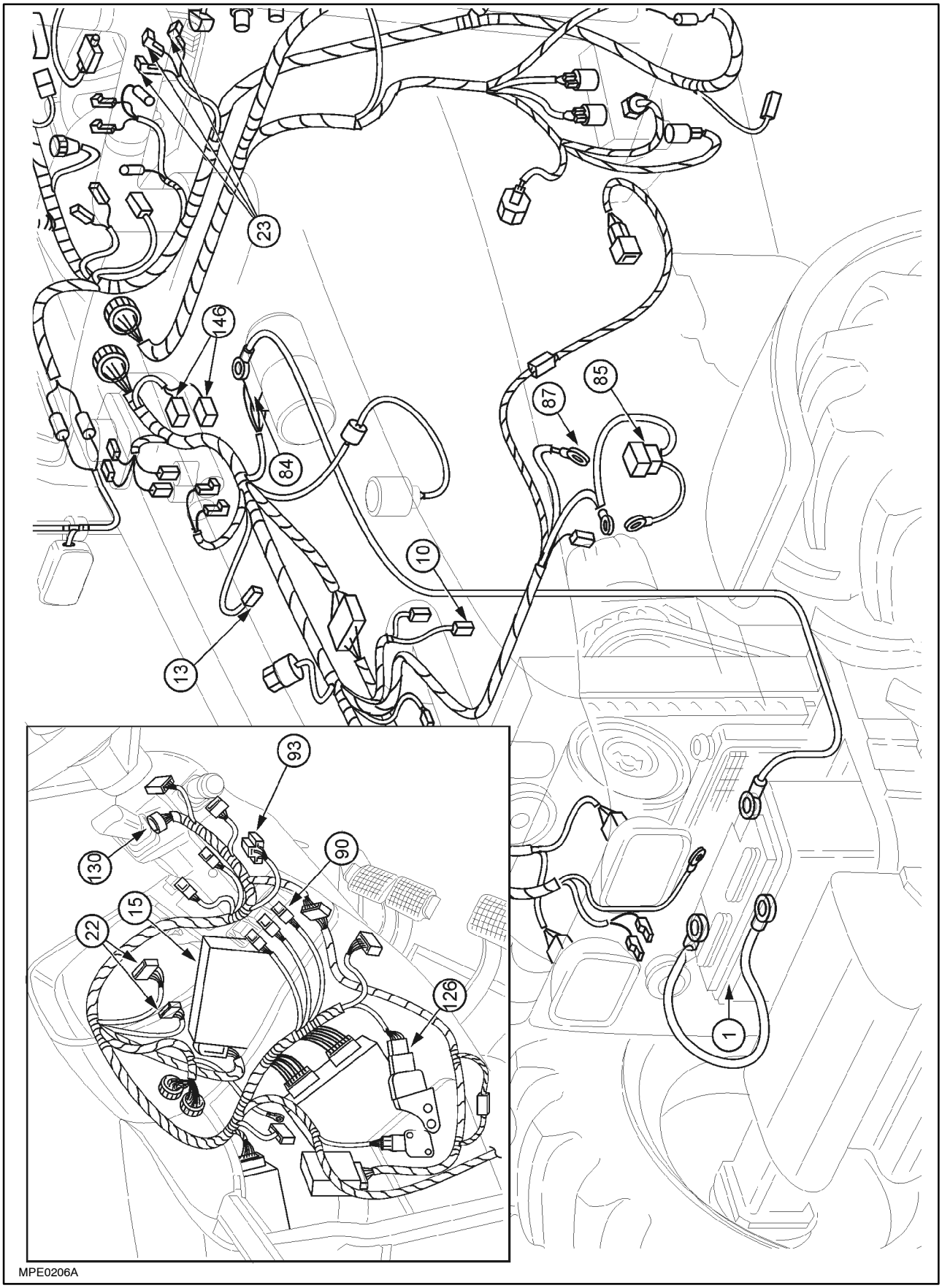
Flasher

MPD2704A

ELECTRICAL CIRCUITS

DESCRIPTION	DIAGRAM
Starter and recharging circuit	A
Operator safety circuit	A/1
Side lights, full beam, dipped beam, number plate and instrument lighting (version with cab)	B
Side lights, full beam, dipped beam, number plate and instrument lighting circuit (Version without cab - ISO)	C
Side lights, full beam, dipped beam, number plate and instrument lighting (version without cab - NASO)	D
Direction indicators and hazard lights circuit (version with cab)	E
Direction indicators and hazard lights circuit (version without cab - NASO)	F
Direction indicator and hazard lights circuit (version without cab - ISO)	G
Work lights, rotating beacon circuit	H
Cab ventilation and air-conditioning system, radio and internal lighting circuit	I
Windscreen wiper/washer, rear windscreen wiper/washer and cigar lighter circuit	L
Differential lock and brake lights circuit (version with Power Shuttle)	M
4WD, trailer brake, PTO circuit (version with Power Shuttle)	N
Transmission circuit (version with Power Shuttle)	O
Differential lock and brake lights circuit [version with Dual Command (2 Speed Power Shift)]	P
4WD, trailer brake, PTO circuit [version with Dual Command (2 Speed Power Shift)]	Q
Transmission circuit [version with Dual Command (2 Speed Power Shift)]	R/1
Transmission circuit [version with Dual Command (2 Speed Power Shift)]	R/2
Differential lock and brake lights circuit (version without cab - ISO)	S
Differential lock and brake lights circuit (version without cab - NASO)	T
Power Shuttle circuit	U/1
Power Shuttle circuit	U/2
Electronic lift circuit (Model Bosch)	V
Dual Command (2 Speed Power Shift) circuit	Z
Power sockets, seven-pole coupling (ISO - NASO) and seat circuit	X
Horn sensors and transmitters circuit	Y
Digital instrument, digital clock circuit	K
Power Shuttle electronic control unit input/output circuit (24 + 24)	W

WIRING DIAGRAM A



17

STARTER AND RECHARGING CIRCUIT (Diagram A)

1 Battery
10 Engine stop electromagnet
13 Thermostarter
15 Fuses and relay control unit
- F12 Trailer brake circuit, instruments, seat safety circuit
- F13 Engine stop electromagnet
- F24 Thermostarter
- I 70 A engine start-up relay

22 Instrument panel
- p Low battery recharge

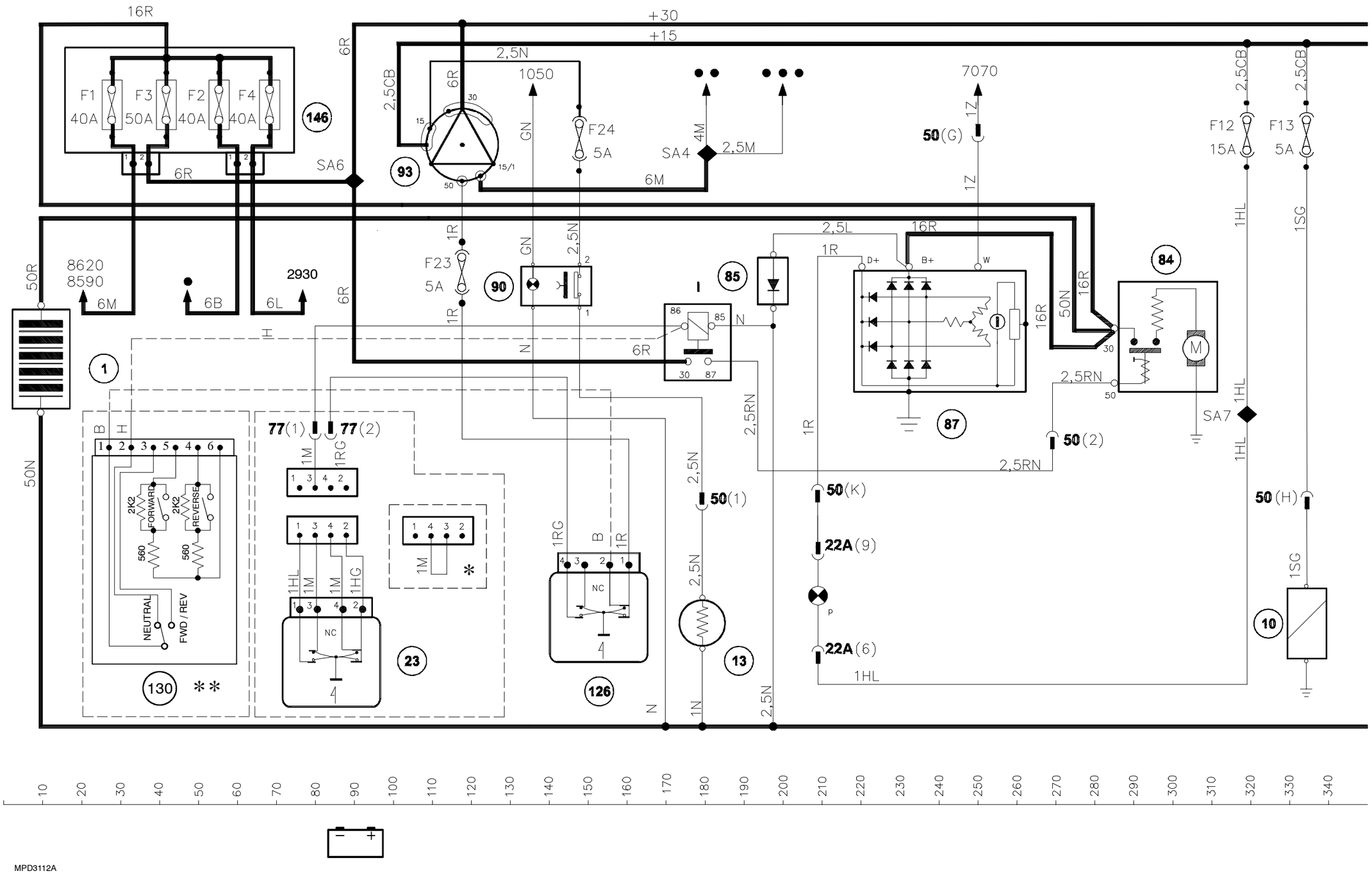
23 Electrohydraulic PTO switch
84 Starter motor
85 Over-voltage protection device
87 Alternator
90 Thermostarter switch
93 Start switch
126 Clutch pedal switch
130 Power Shuttle control lever
146 Maxi fuse box
- 1) 40 A - 40 A power socket
- 2) 40 A - Fuse power supply 3-4-7-8-9-10-11
- 3) 50 A - Power supply 1-2-12-13-14-15-16-17-18-20-21-22-23-24 and starter circuit
- 4) 40 A - Fuse power supply 5-6-19 and work lights circuit

* Jumper for mechanical PTO version.

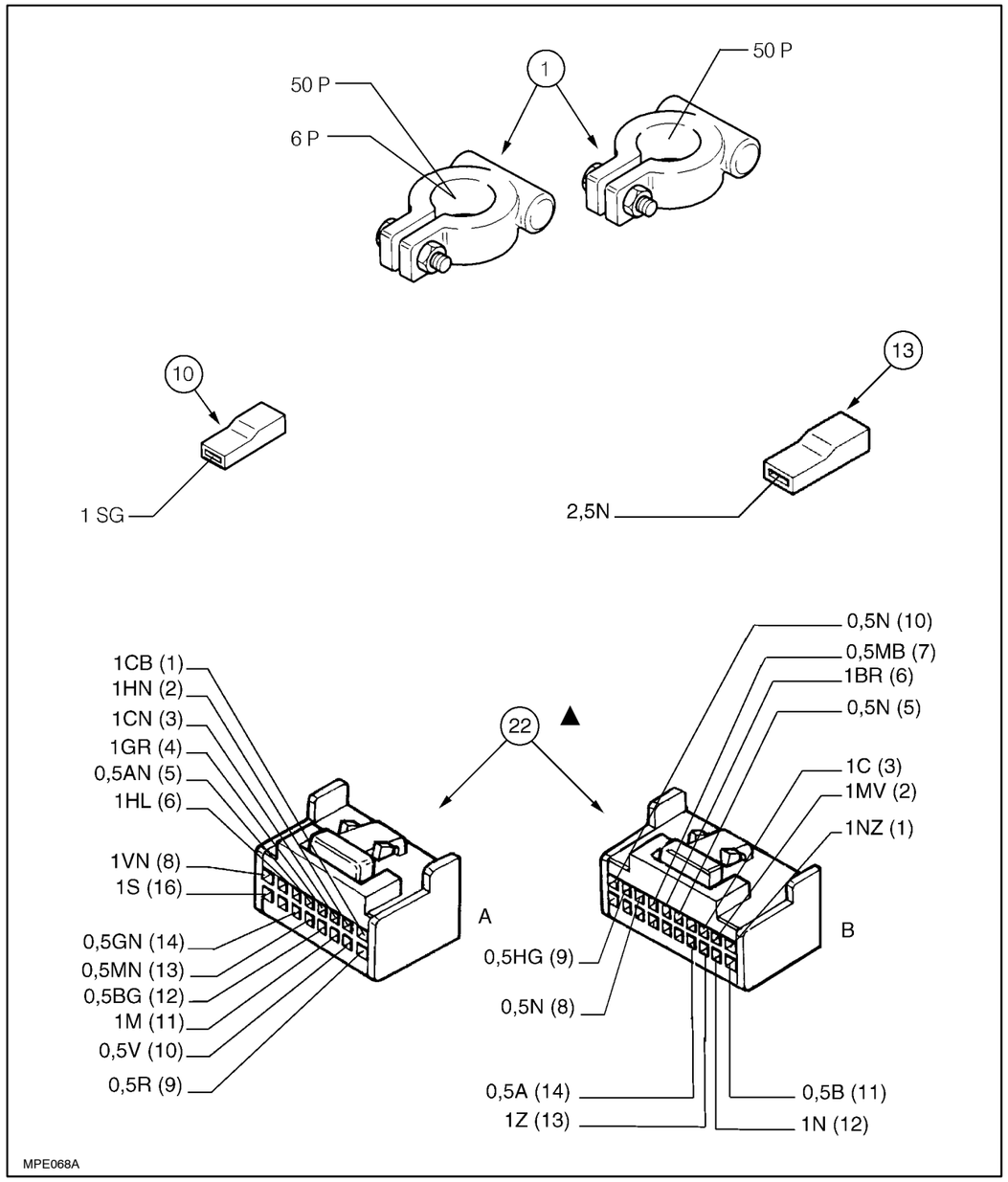
** Lead for version with Power Shuttle.

●	●●	●●●
490 Operator safety circuit	**3380** Ventilation and cab lights	**400** Operator safety circuit
780 Lights with cab	**4150** Power Shuttle differential lock brake lights	**1370** ISO lights without cab
1130 ISO lights without cab	**5240** Dual Command (2 Speed Power Shift) differential lock brake lights	**1740** NASO lights without cab
1480 NASO lights without cab	**6620** Differential lock Brake lights ISO version without cab	**3320** Cab ventilation and lights
1900 Hazard lights with cab - NASO	**6970** Differential lock brake lights NASO version without cab	**3840** Windscreen wipers and cigar lighter
2250 Hazard lights NASO version without cab	**8570** Power socket. NASO seat	**4190** Power Shuttle differential lock brake lights
2680 Hazard lights ISO without cab	**9440** Instrument digital clock	**4610** Power-Shuttle transmission circuit
2860 Work lights-Rotating beacon		**5200** Dual Command (2 Speed Power Shift) - Differential lock Brake lights
3280 Cab ventilation and lights		**5310** 4WD Trailer brake PTO [Dual Command (2 Speed Power Shift)]
3590 Windscreen wipers-cigar lighter		**6600** Differential lock Brake lights ISO version without cab
7040 Power Shuttle		**6950** Differential lock Brake lights NASO version without cab
8550 Power socket. NASO seat		**8850** Horn Sensors
9120 Instrument Digital clock		**8970** Horn Sensors

STARTER AND RECHARGING CIRCUIT - DIAGRAM A

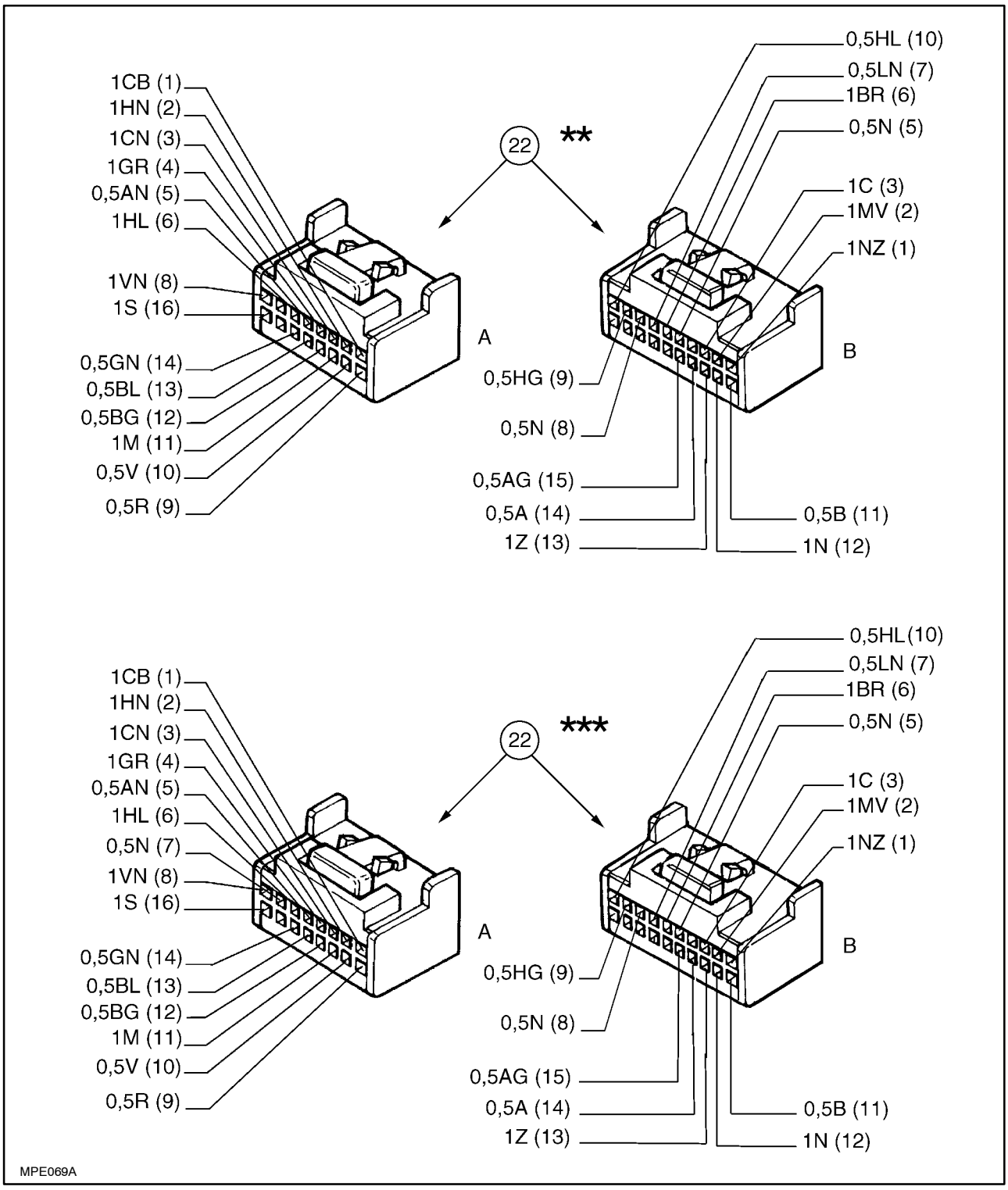


MPD3112A



18

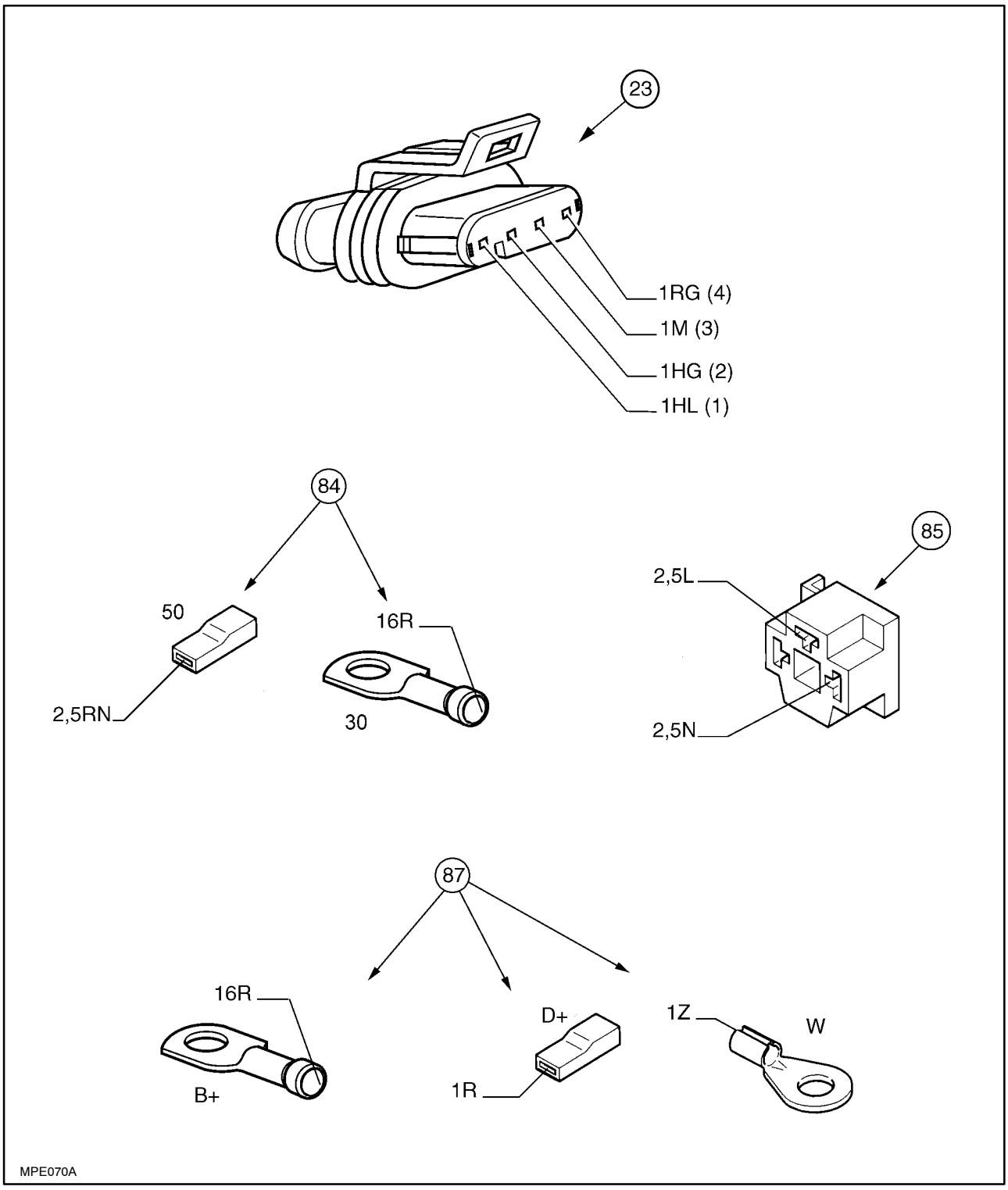
▲ Version with Dual Command (2 Speed Power Shift)



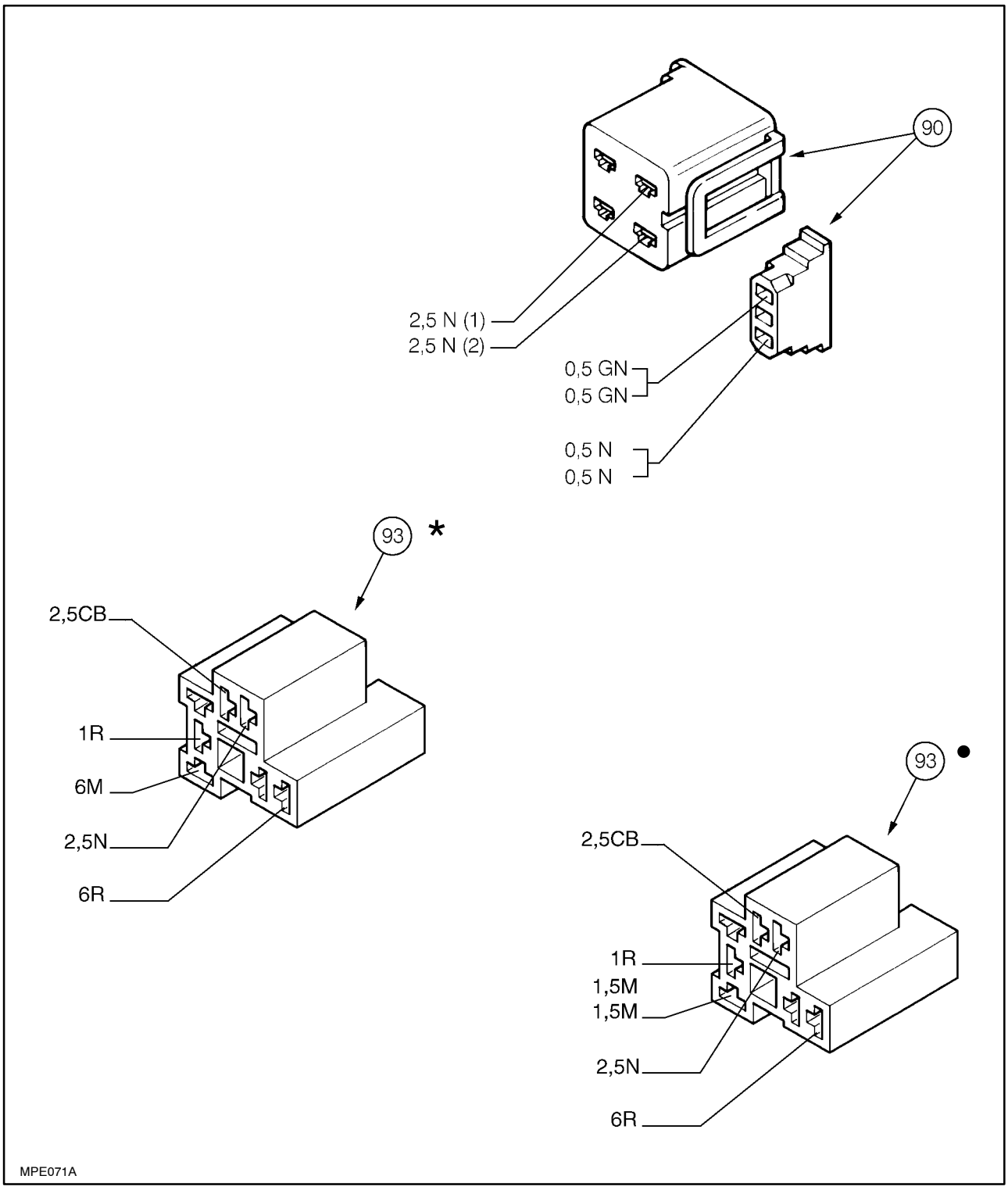
19

** Version without cab

*** Power Shuttle version


23
1RG (4)
1M (3)
1HG (2)
1HL (1)
84
50
2,5RN
16R
30
85
2,5L
2,5N
87
16R
B+
D+
1R
1Z
W
MPE070A

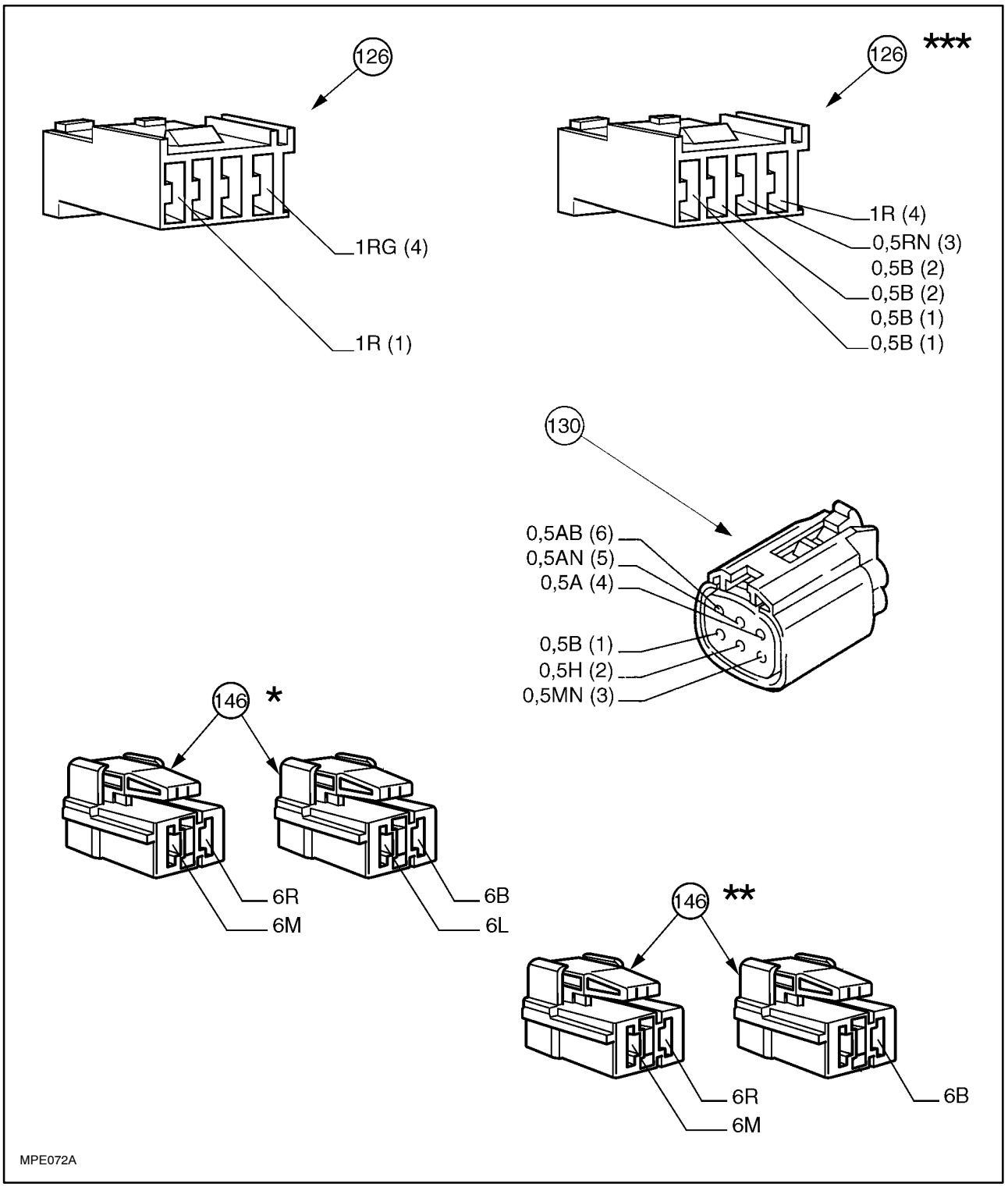
20



21

* Version with cab

● Version without cab (ISO)



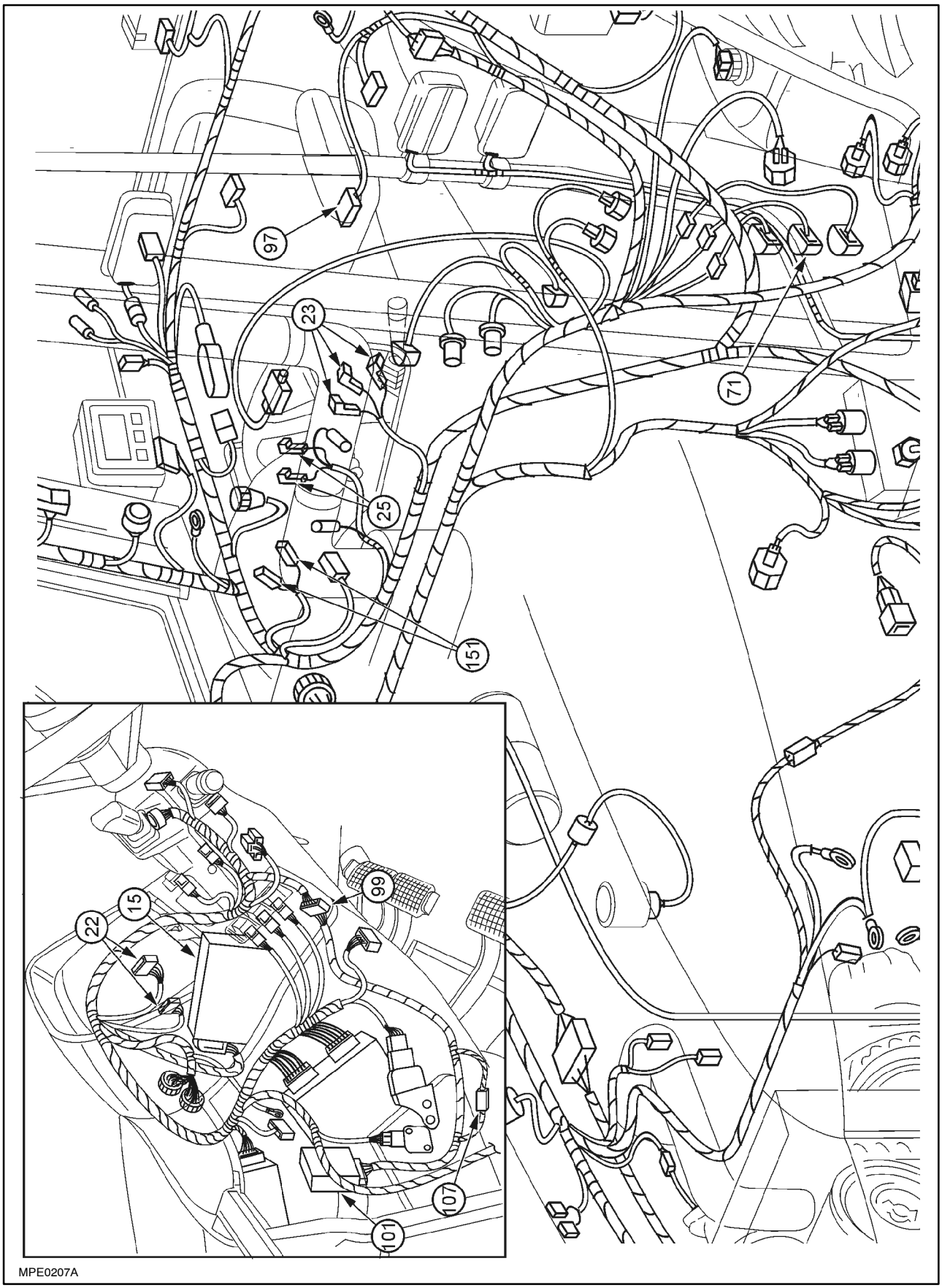
22

* Version with cab

** Version without cab

*** Power Shuttle version

WIRING DIAGRAM A/1



MPE0207A

23

OPERATOR SAFETY CIRCUIT
(Diagram A/1)

15 Fuses and relay control unit
- F11 Horn, 8A power socket, cigar lighter, rotating beacon
- F12 Trailer brake circuit, instruments, seat safety circuit
- F18 Rear power take-off circuit
- F Electrohydraulic PTO circuit
- G Electrohydraulic PTO circuit

22 Instrument panel
- I Handbrake ON
- s PTO ON

23 Electrohydraulic PTO switch

25 Parking brake switch

71 Rear PTO solenoid valve

77 Transmission side system connection (24 PIN)

97 Seat safety switch

99 Safety circuit connection (8 PIN)

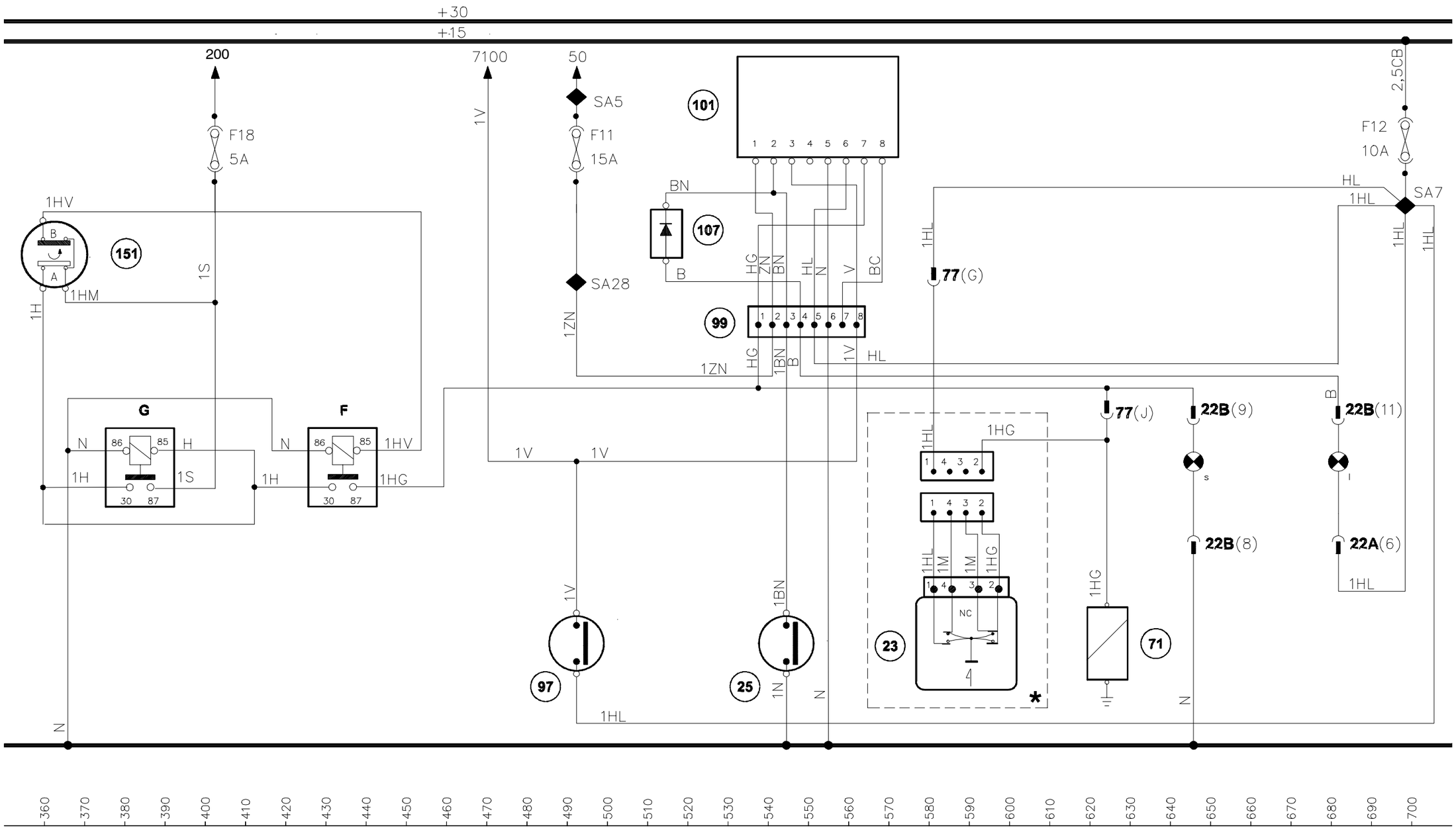
101 Alarm module

107 Diode (only for NASO version)

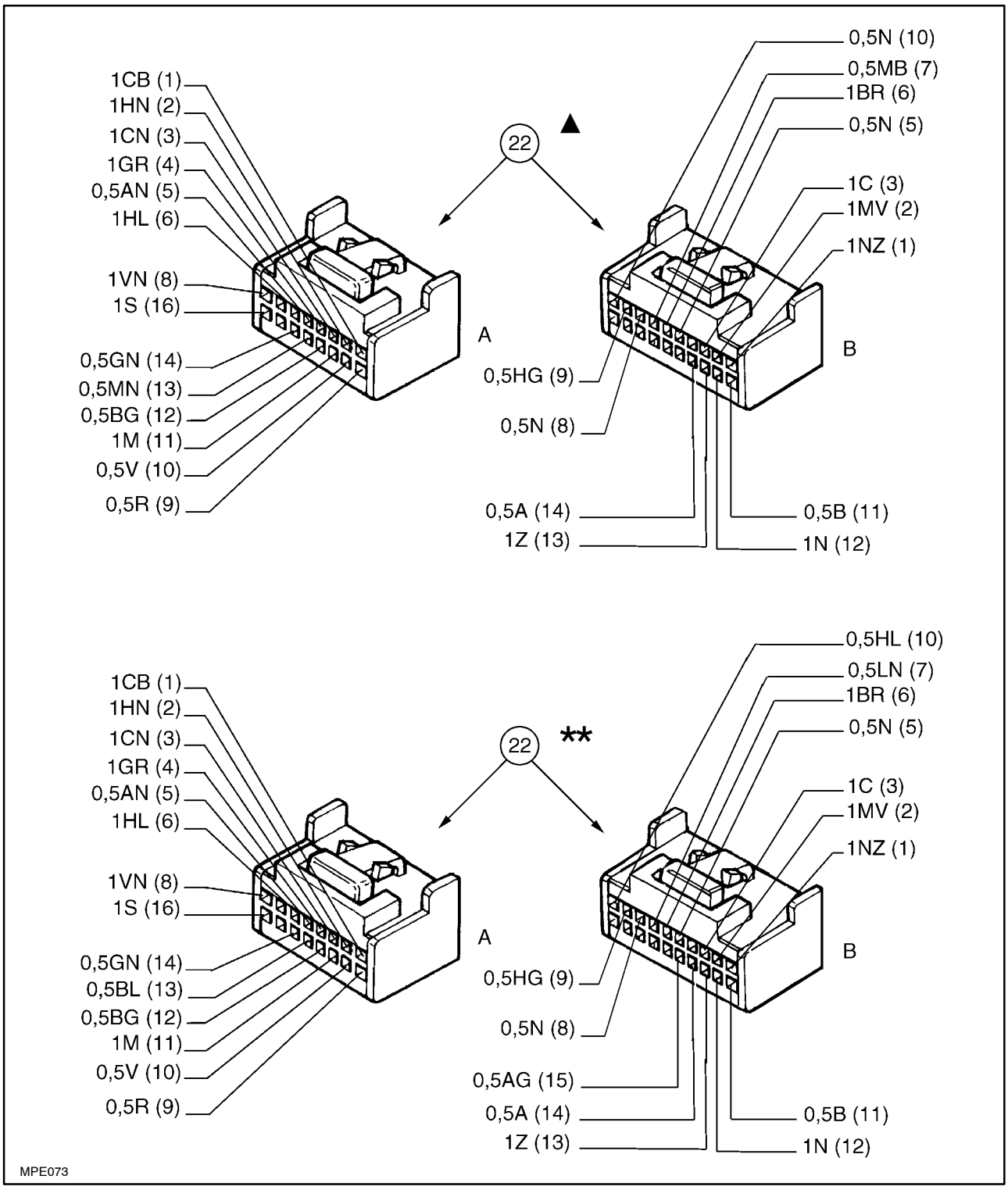
151 Rear PTO switch

* For version with electrohydraulic PTO.

OPERATOR SAFETY CIRCUIT - DIAGRAM A/1



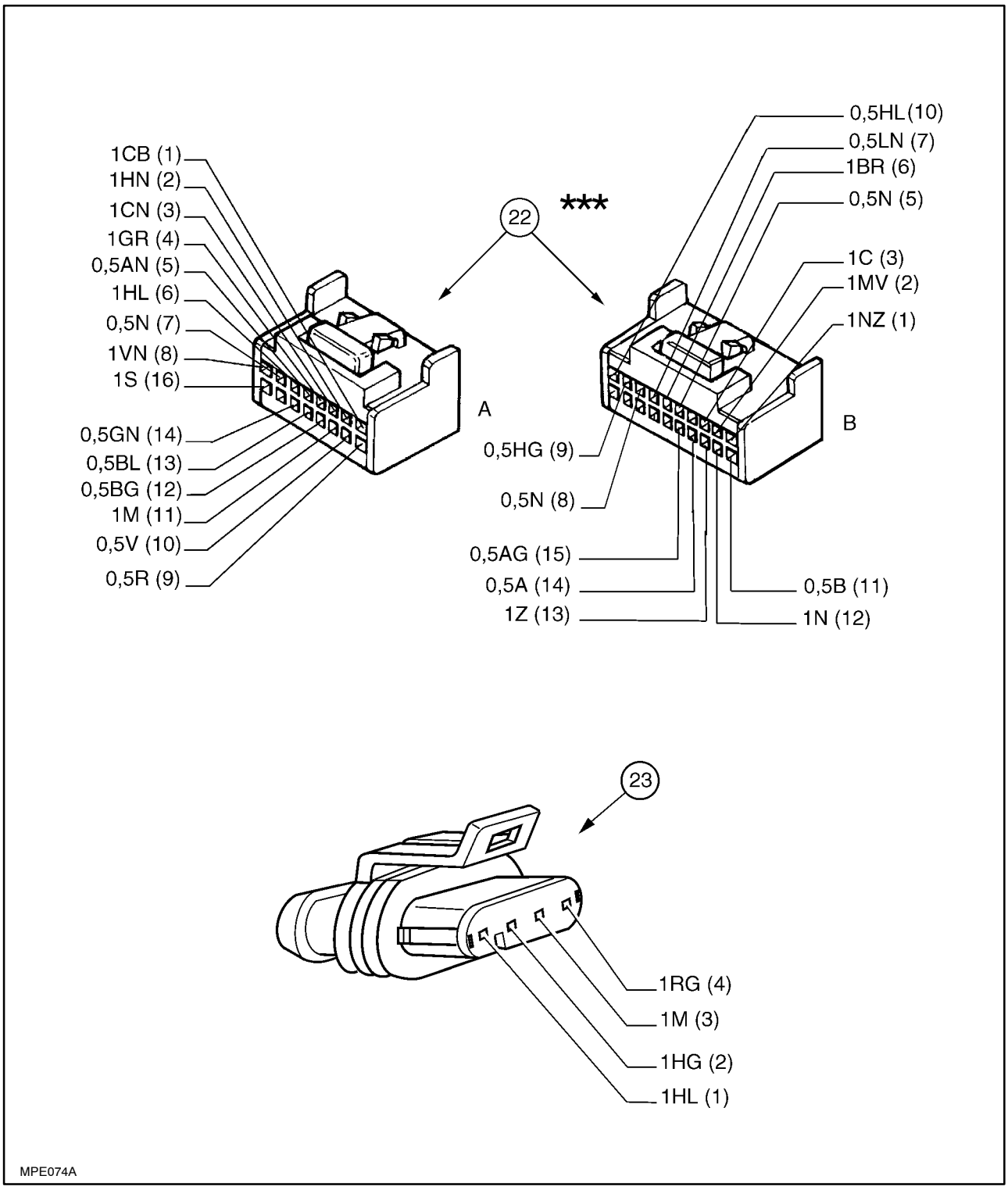
MPD3113A



24

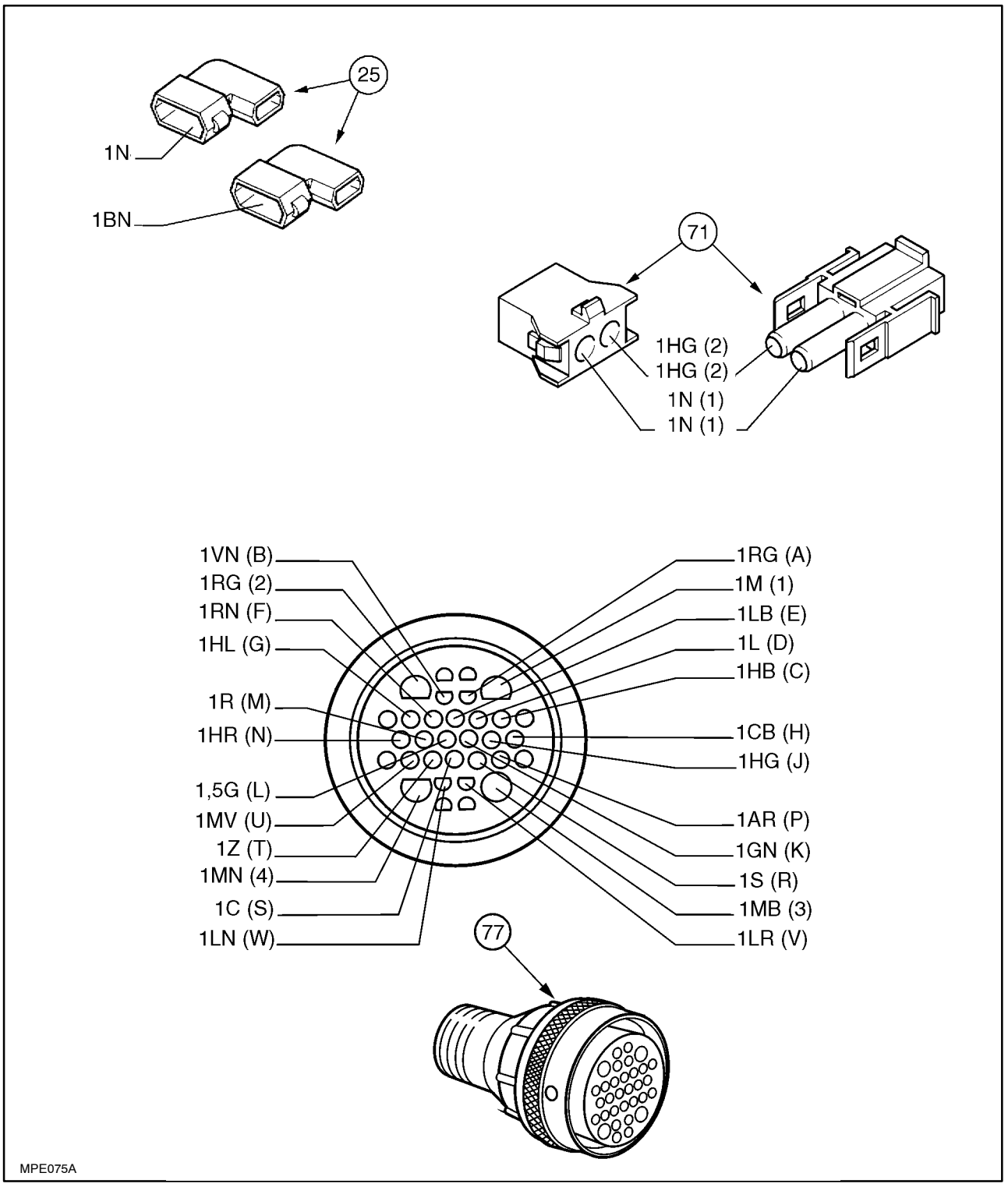
▲ Version with Dual Command (2 Speed Power Shift)

** Version without cab

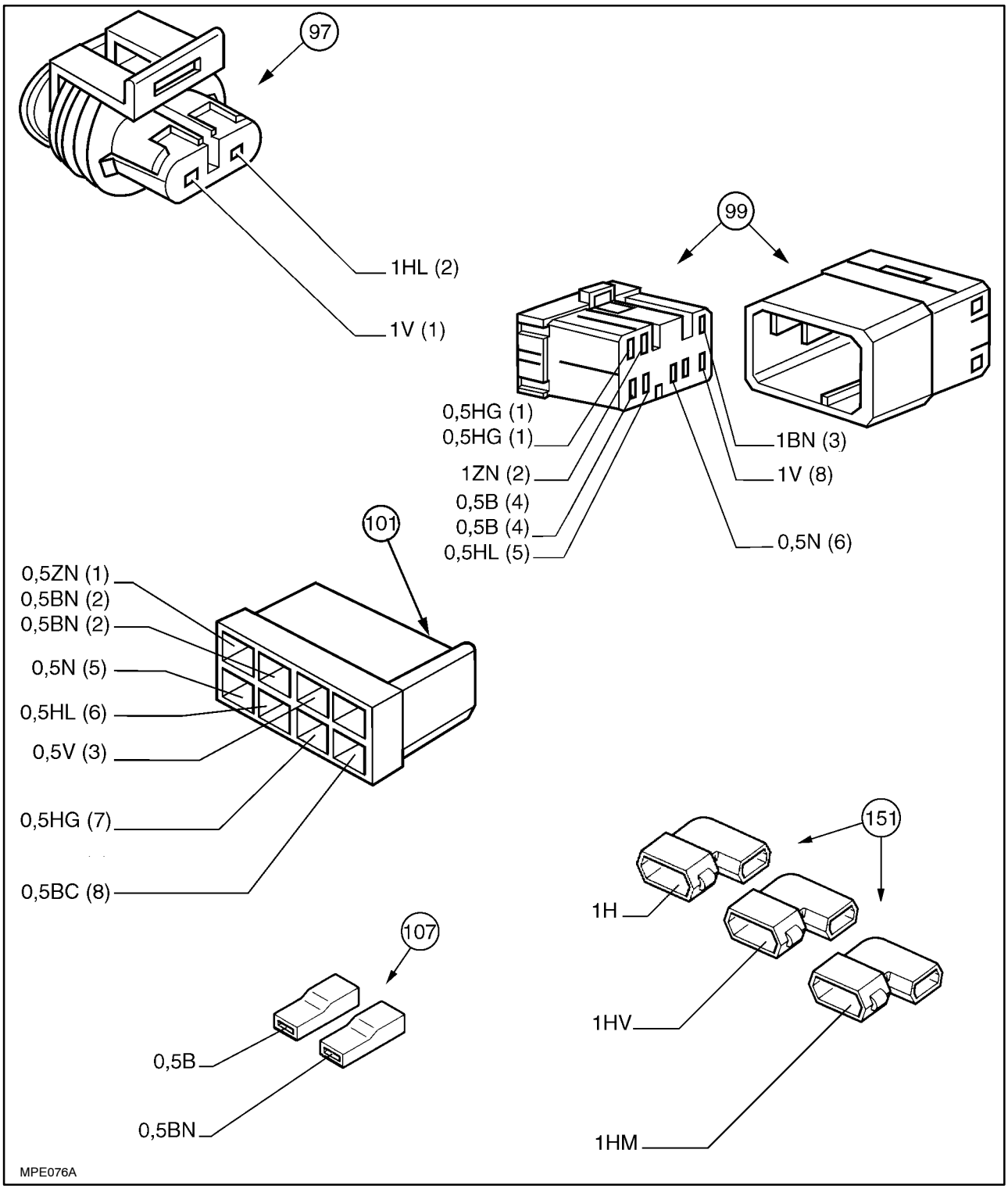


25

*** Power Shuttle version

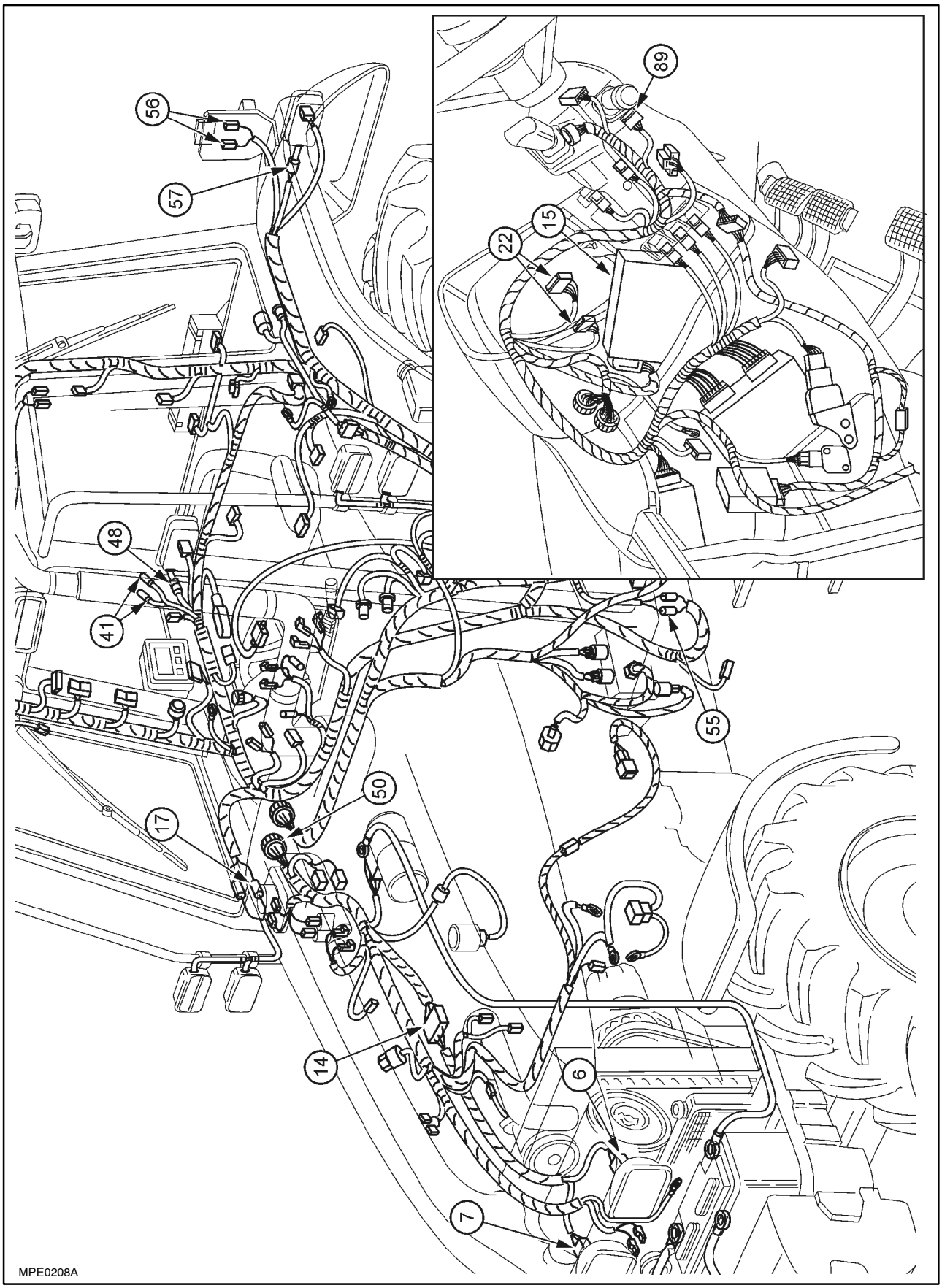

25
1N
1BN
71
1HG (2)
1HG (2)
1N (1)
1N (1)
1VN (B)
1RG (2)
1RN (F)
1HL (G)
1R (M)
1HR (N)
1,5G (L)
1MV (U)
1Z (T)
1MN (4)
1C (S)
1LN (W)
1RG (A)
1M (1)
1LB (E)
1L (D)
1HB (C)
1CB (H)
1HG (J)
1AR (P)
1GN (K)
1S (R)
1MB (3)
1LR (V)
77
MPE075A

26


97
1HL (2)
1V (1)
99
0,5HG (1)
0,5HG (1)
1ZN (2)
0,5B (4)
0,5B (4)
0,5HL (5)
1BN (3)
1V (8)
0,5N (6)
101
0,5ZN (1)
0,5BN (2)
0,5BN (2)
0,5N (5)
0,5HL (6)
0,5V (3)
0,5HG (7)
0,5BC (8)
107
0,5B
0,5BN
151
1H
1HV
1HM
MPE076A

27

WIRING DIAGRAM B



SIDE LIGHTS, FULL BEAM, DIPPED BEAM CIRCUIT, NUMBER PLATE AND INSTRUMENT LIGHTING (Version with cab) (Diagram B)

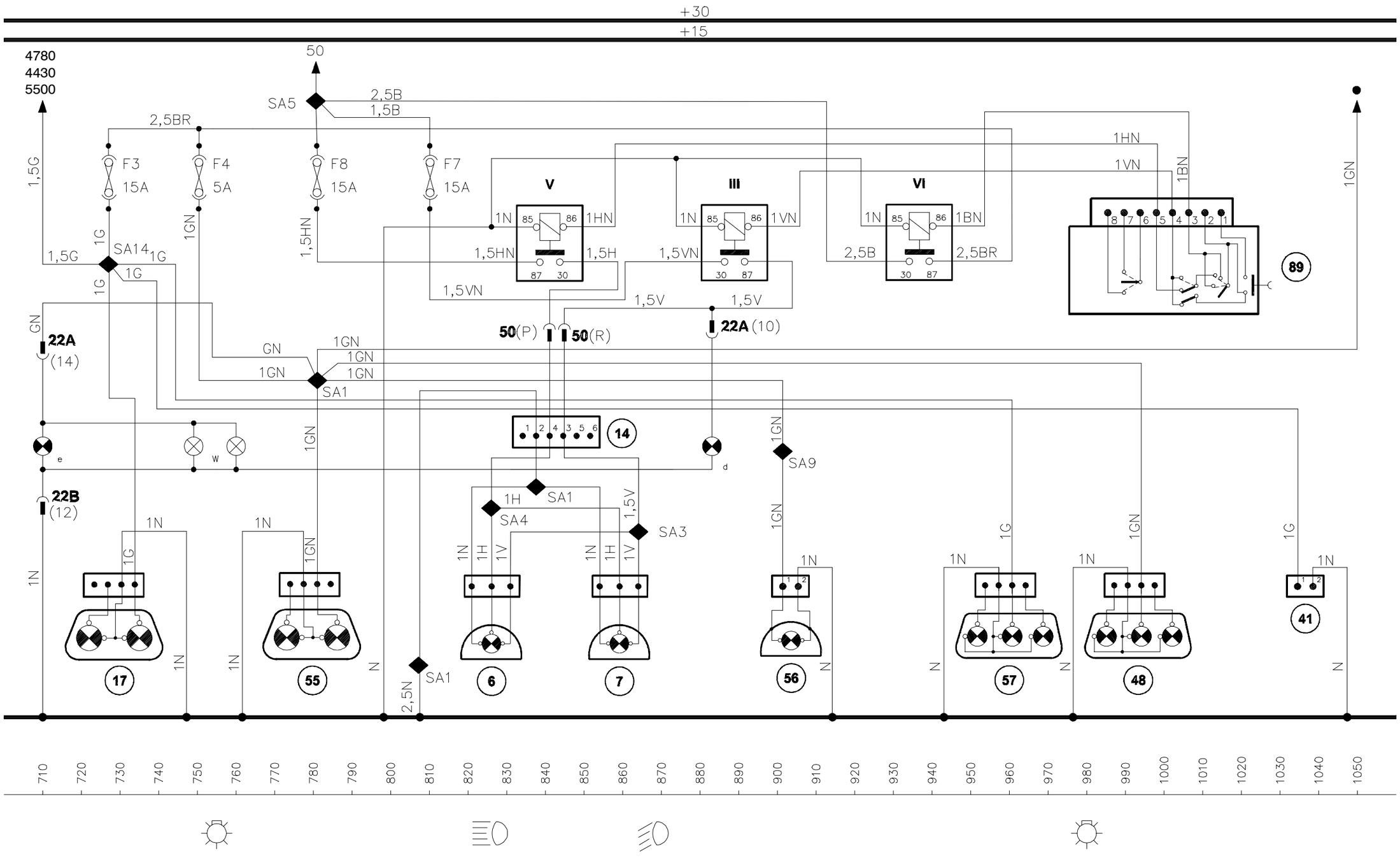
6 Front LH headlamp
7 Front RH headlamp
14 Front lights connection
15 Fuses and relay control unit
- F3 Front right-hand and left-hand side lights, NASO 7-pole connector
- F4 Front left-hand and rear right-hand side lights, control instrument panel light
- F7 Full beam headlights
- F8 Dipped beam headlights
- III Full beam headlight circuit
- V Dipped beam headlight circuit
- VI Side lights circuit

17 Sidelights and RH front direction indicator
22 Instrument panel
- e Side lights
- d Full beam headlights
- w Instrument lighting

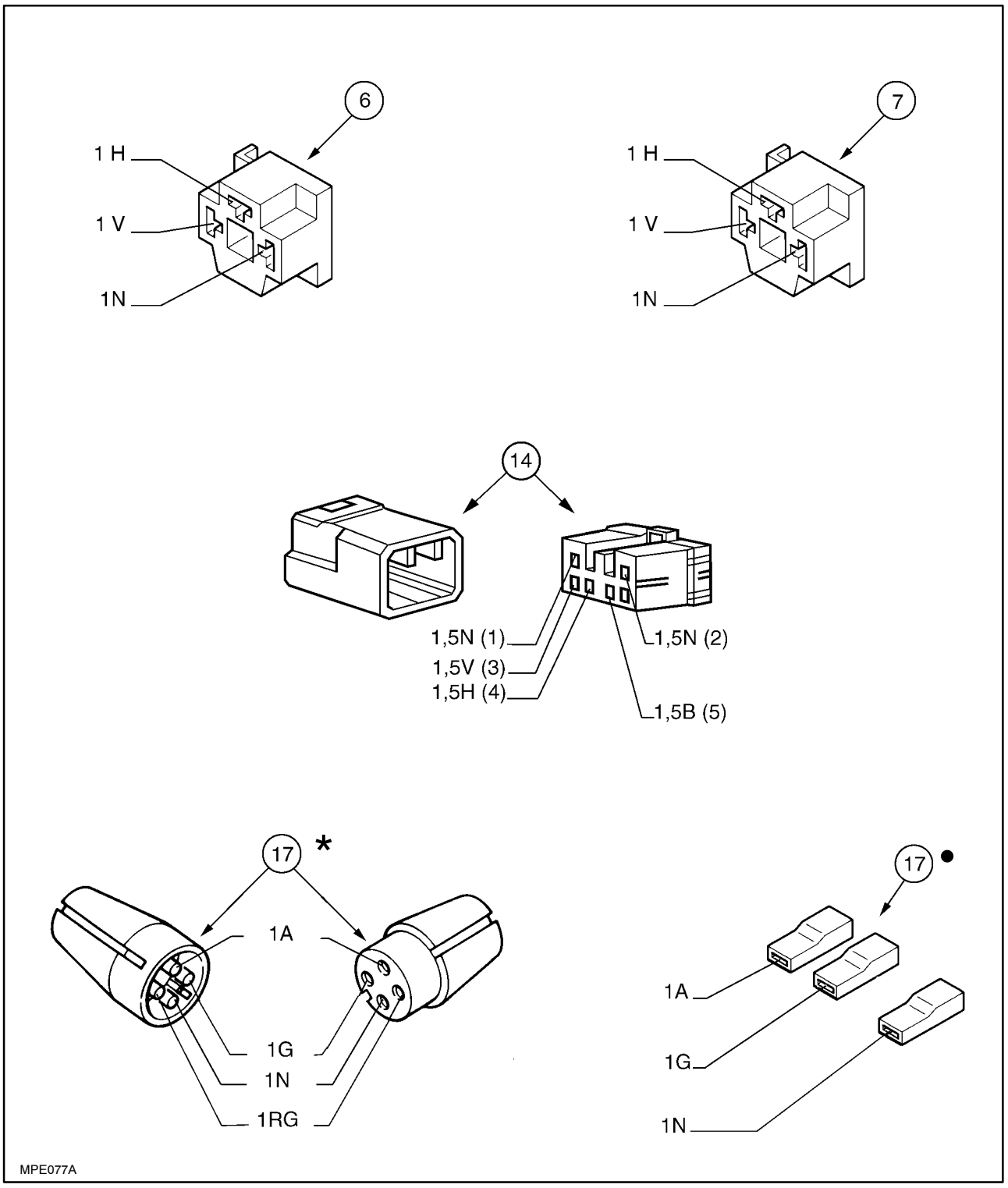
41 RH number plate light (USA version)
48 RH tail light
50 Front main connection (24 PIN)
55 Side lights and LH front direction indicator
56 Number plate light
57 LH tail light
89 External lights control switch

●
140 Starter circuit
3090 Work lights - rotating beacon
3500 Ventilation - air-conditioning - radio - cab lights
3620 Windscreen wiper/washer - rear windscreen wiper/washer - cigar lighter
4460 4WD - Trailer brake - PTO (Power-Shuttle)
5510 4WD - trailer brake - PTO [Dual Command (2 Speed Power Shift)]
6650 Differential lock - Brake light (without cab - ISO)
7000 Differential lock - Brake lights (without cab - NASO)
9390 Digital instrument - Digital clock

SIDE LIGHTS, FULL BEAM, DIPPED BEAM CIRCUIT, NUMBER PLATE AND INSTRUMENT LIGHTING (Version with cab) - DIAGRAM B



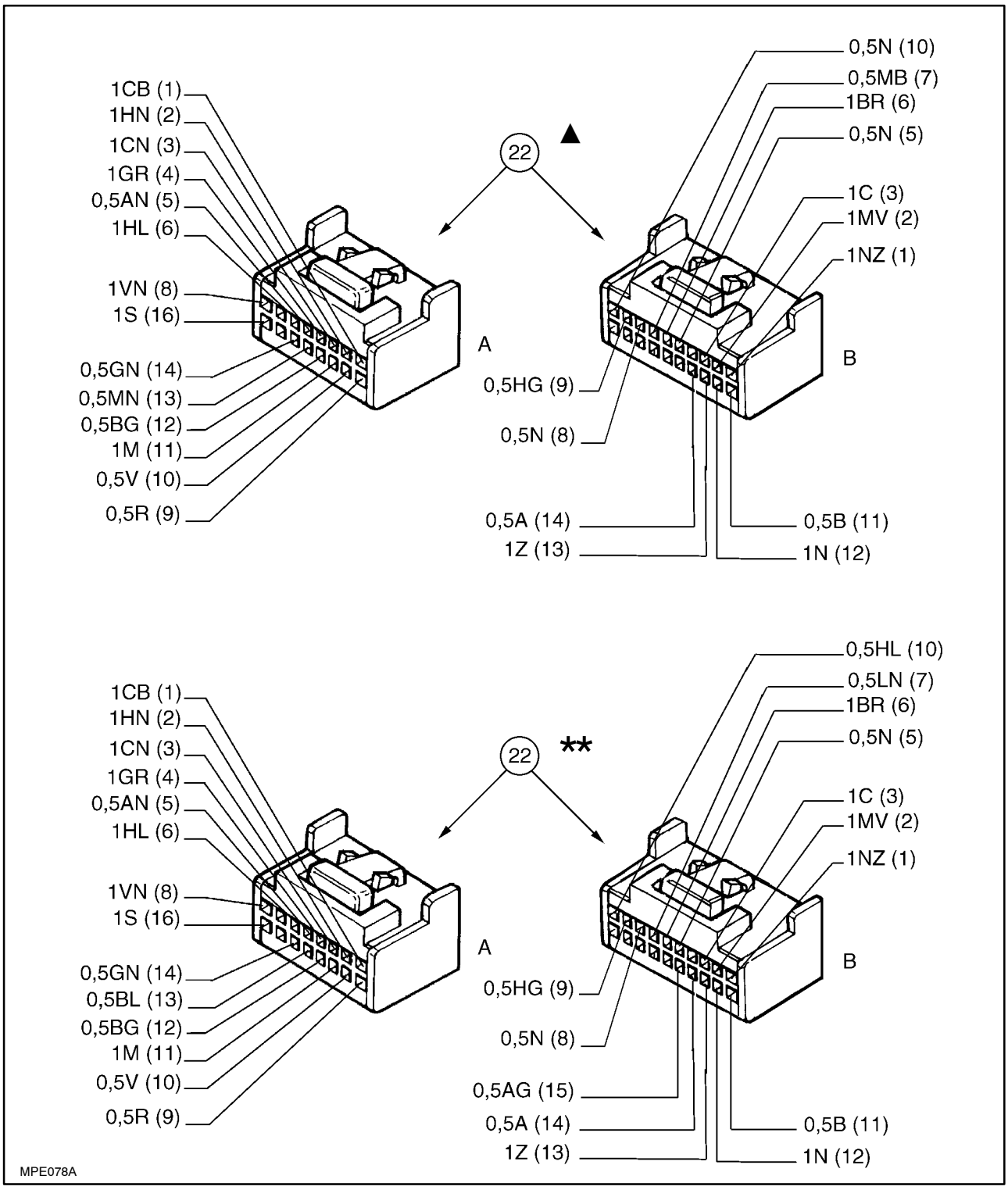
MPD3114A



29

* Version with cab

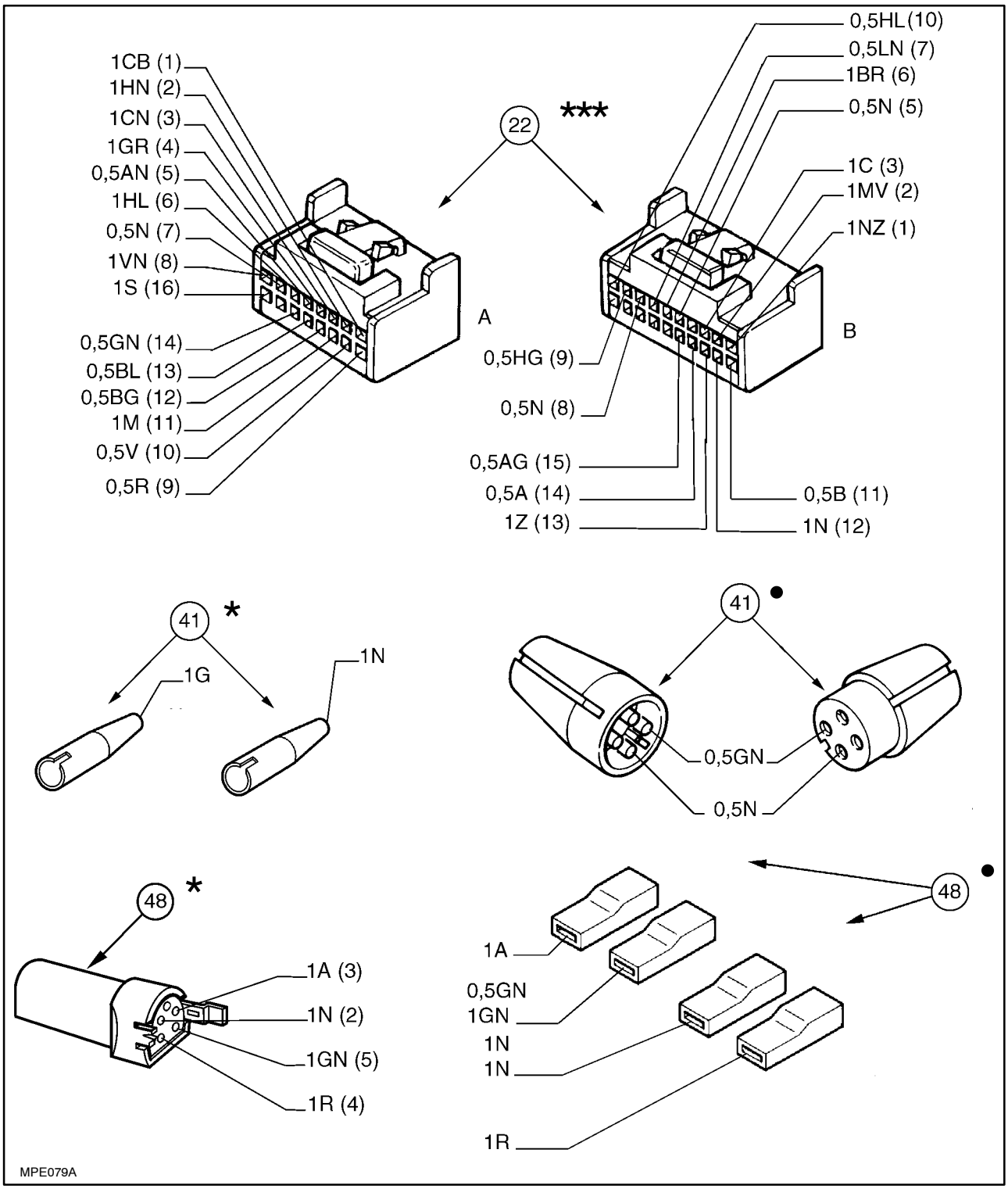
● Version without cab (ISO)



30

▲ Version with Dual Command (2 Speed Power Shift)

** Version without cab

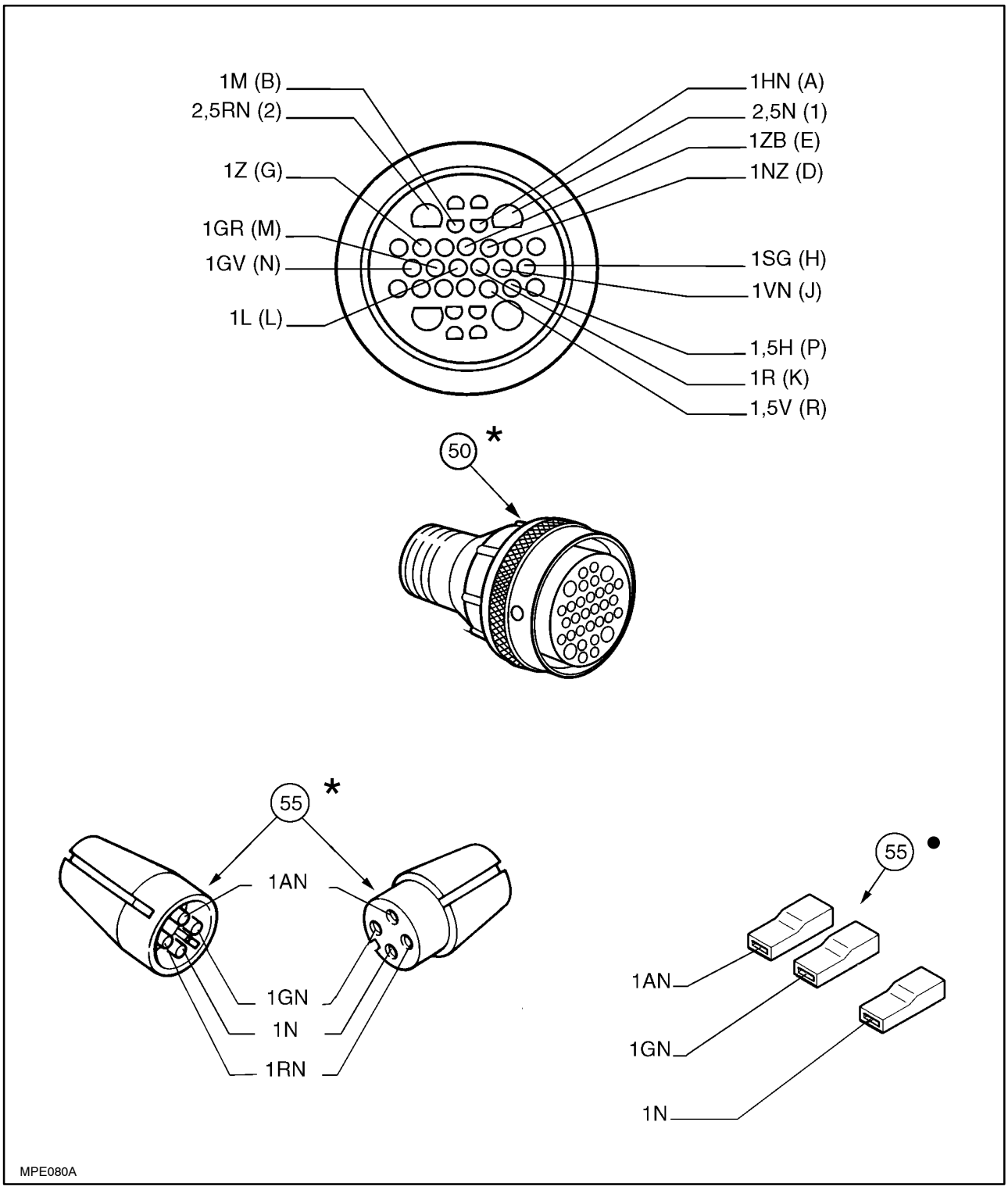


31

* Version with cab

*** Power Shuttle version

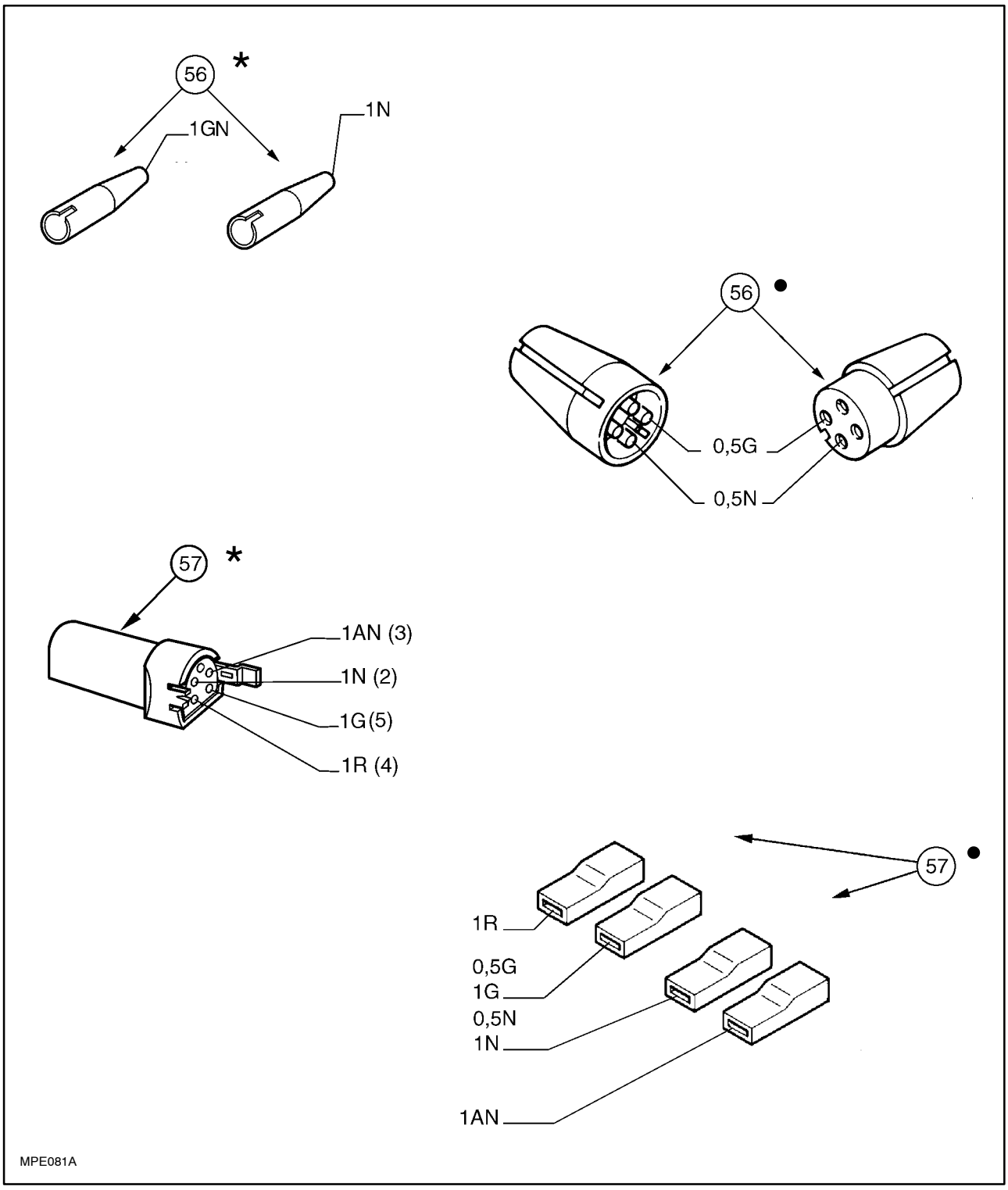
● Version without cab (ISO)



32

* Version with cab

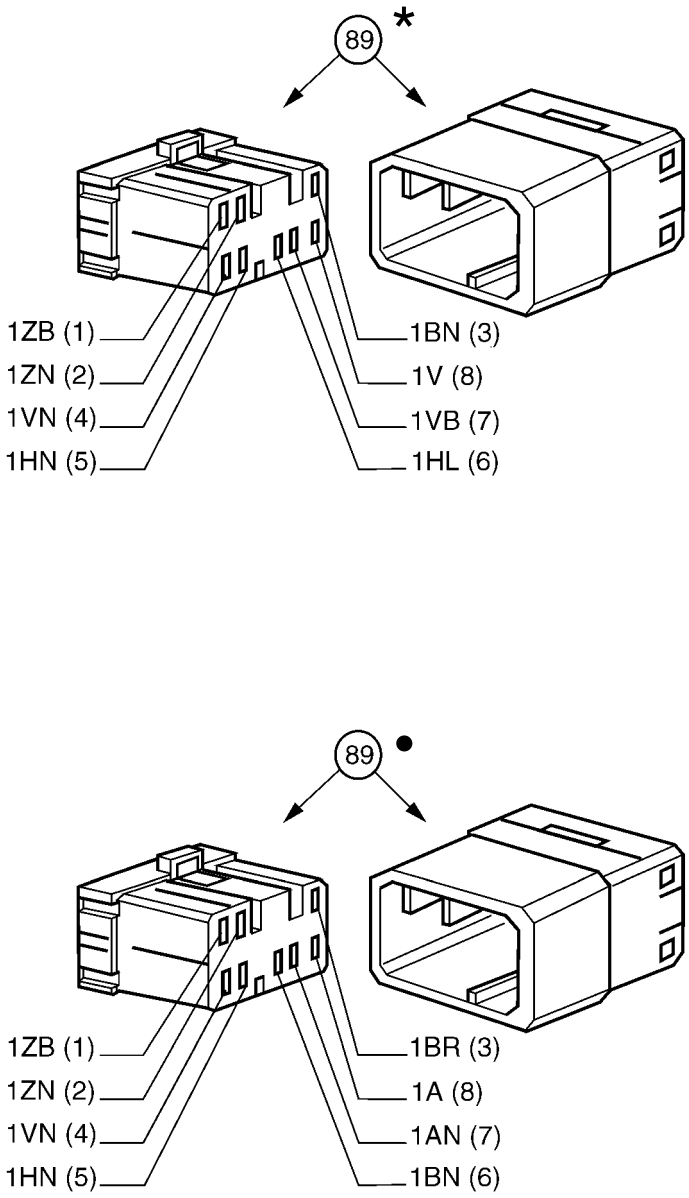
● Version without cab (ISO)



33

* Version with cab

● Version without cab (ISO)

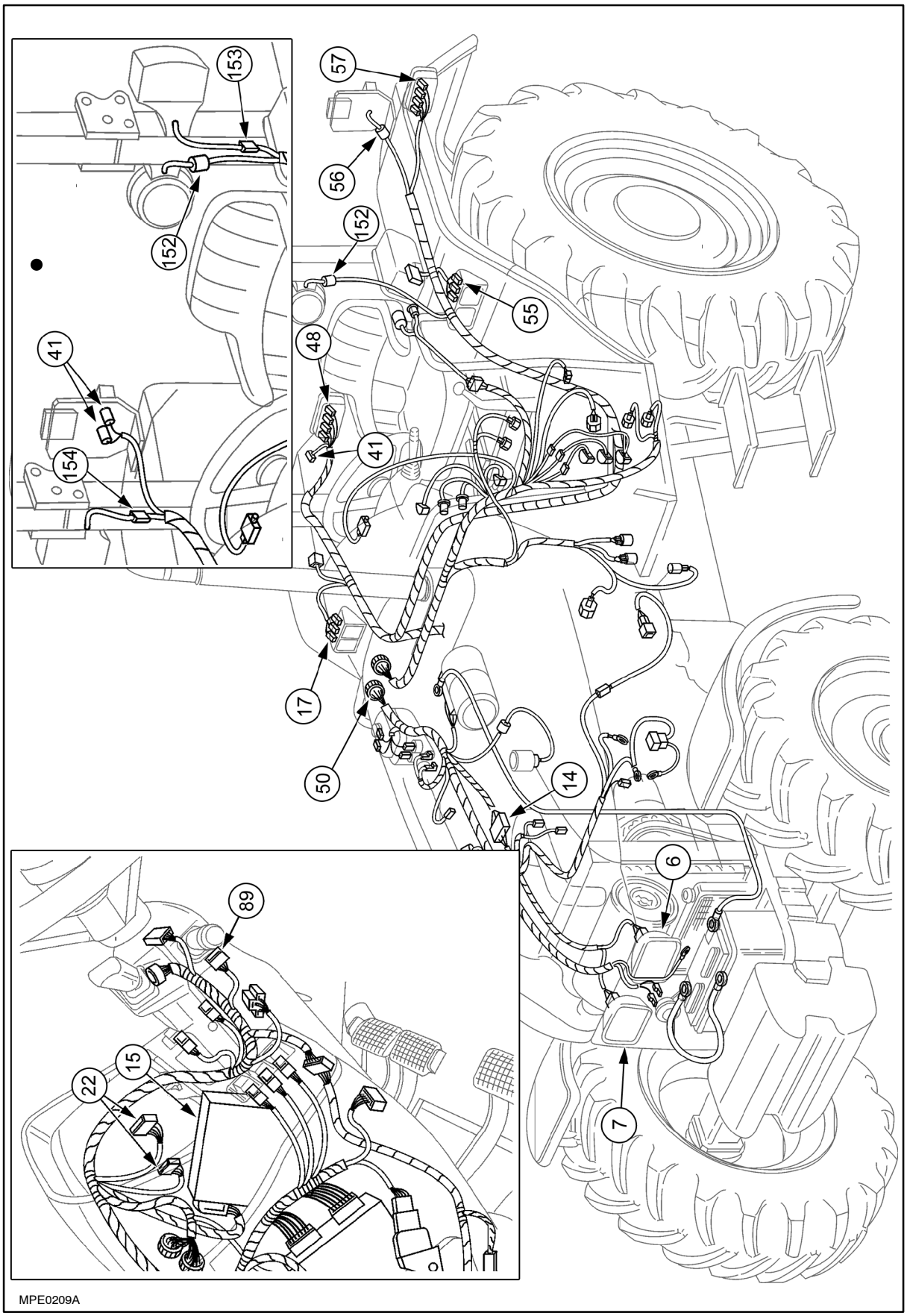


34

* Version with cab

• Version without cab (ISO)

WIRING DIAGRAMS C - D



• NASO version

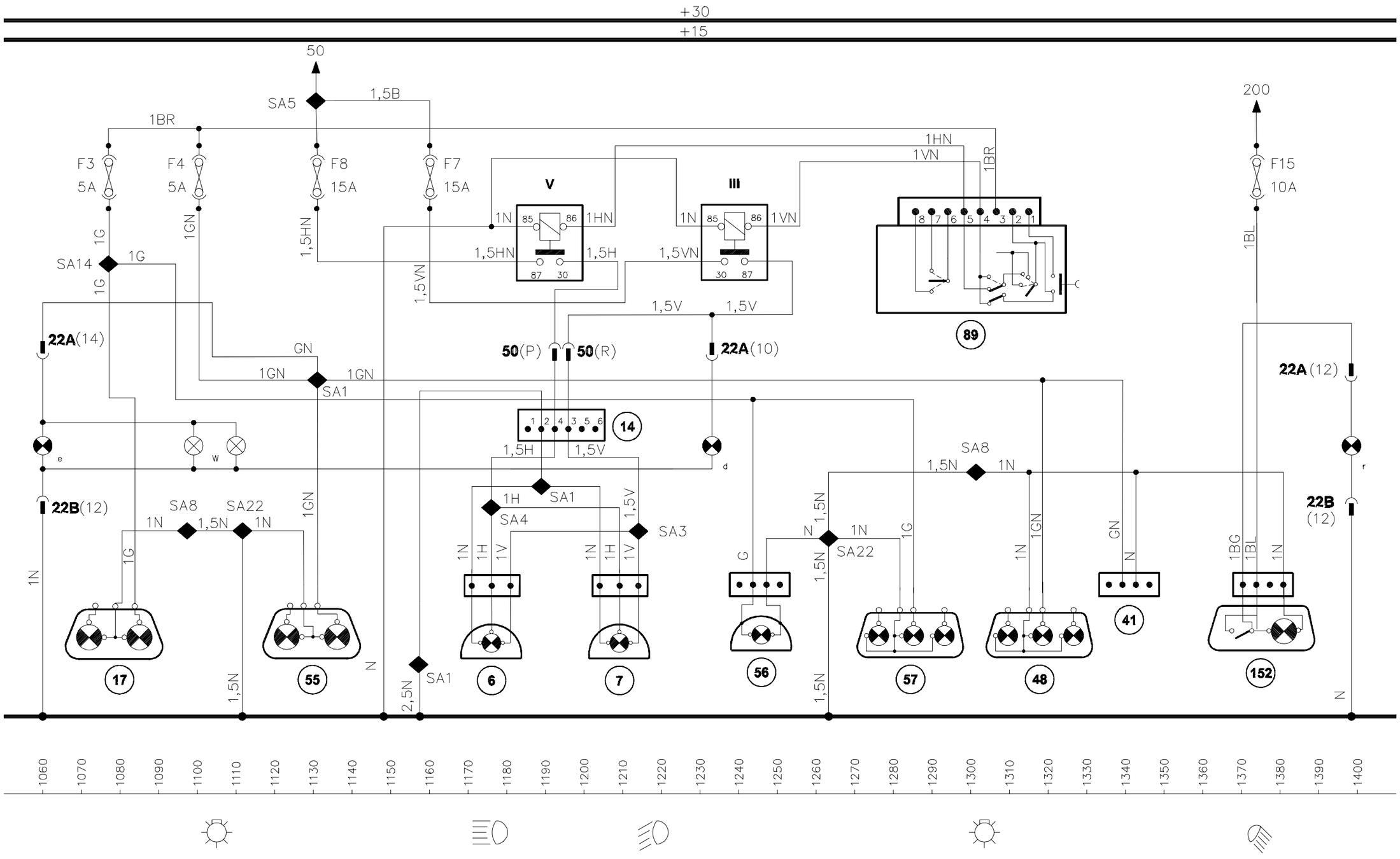
SIDE LIGHTS, FULL BEAM, DIPPED BEAM, NUMBER PLATE AND INSTRUMENT LIGHTING CIRCUIT (Version without cab - ISO) (Diagram C)

6 Front LH headlamp
7 Front RH headlamp
14 Front lights connection
15 Fuses and relay control unit
- F3 Front right-hand and rear left-hand side lights, side lights indicator
- F4 Front left-hand and rear right-hand side lights, control instrument panel light
- F7 Full beam headlights
- F8 Dipped beam headlights
- F15 Rear work light
- III Full beam headlight circuit
- V Dipped beam headlight circuit

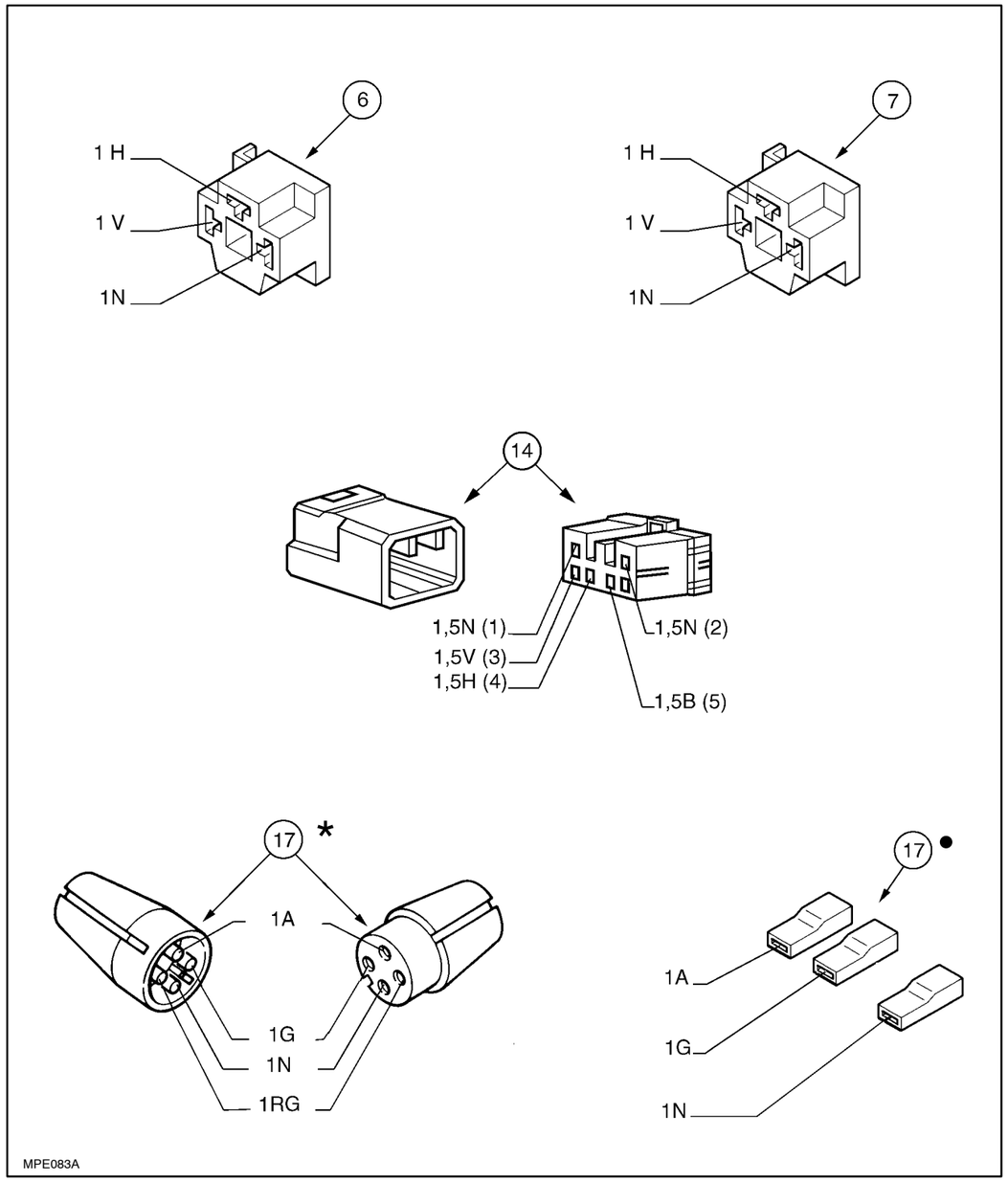
17 RH front direction indicator and side light
22 Instrument panel
- e Side/tail lights
- d Full beam headlights
- w Instrument lighting

41 RH number plate light (USA version)
48 RH tail light
50 Front main connection (24 PIN)
55 LH front direction indicator and side light
56 Number plate light
57 LH tail light
89 External lights control switch
152 Rear work light (version without cab)

SIDE LIGHTS, FULL BEAM, DIPPED BEAM, NUMBER PLATE AND INSTRUMENT LIGHTING CIRCUIT (Version without cab - ISO) - DIAGRAM C



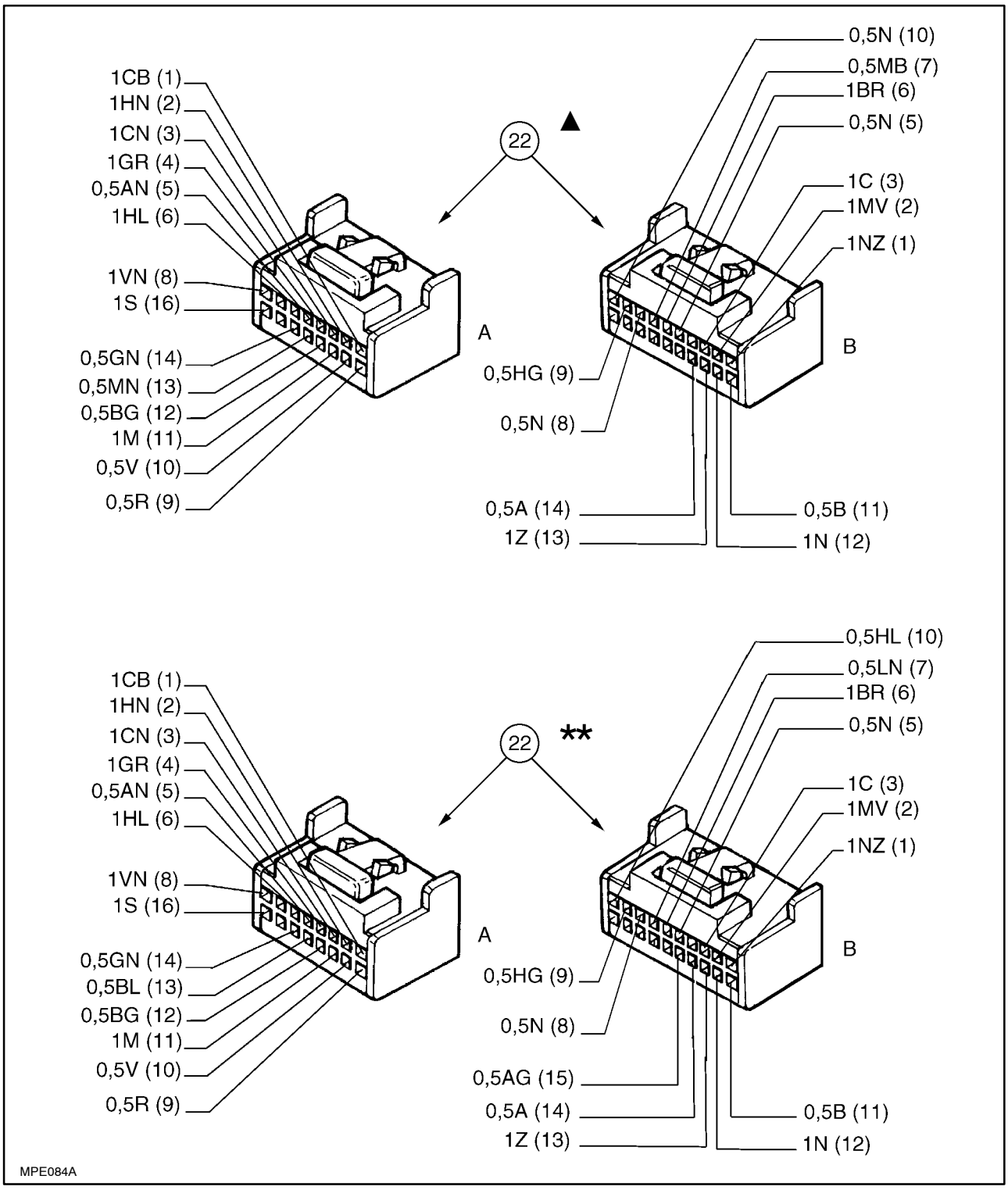
MPD3115A



36

* Version with cab

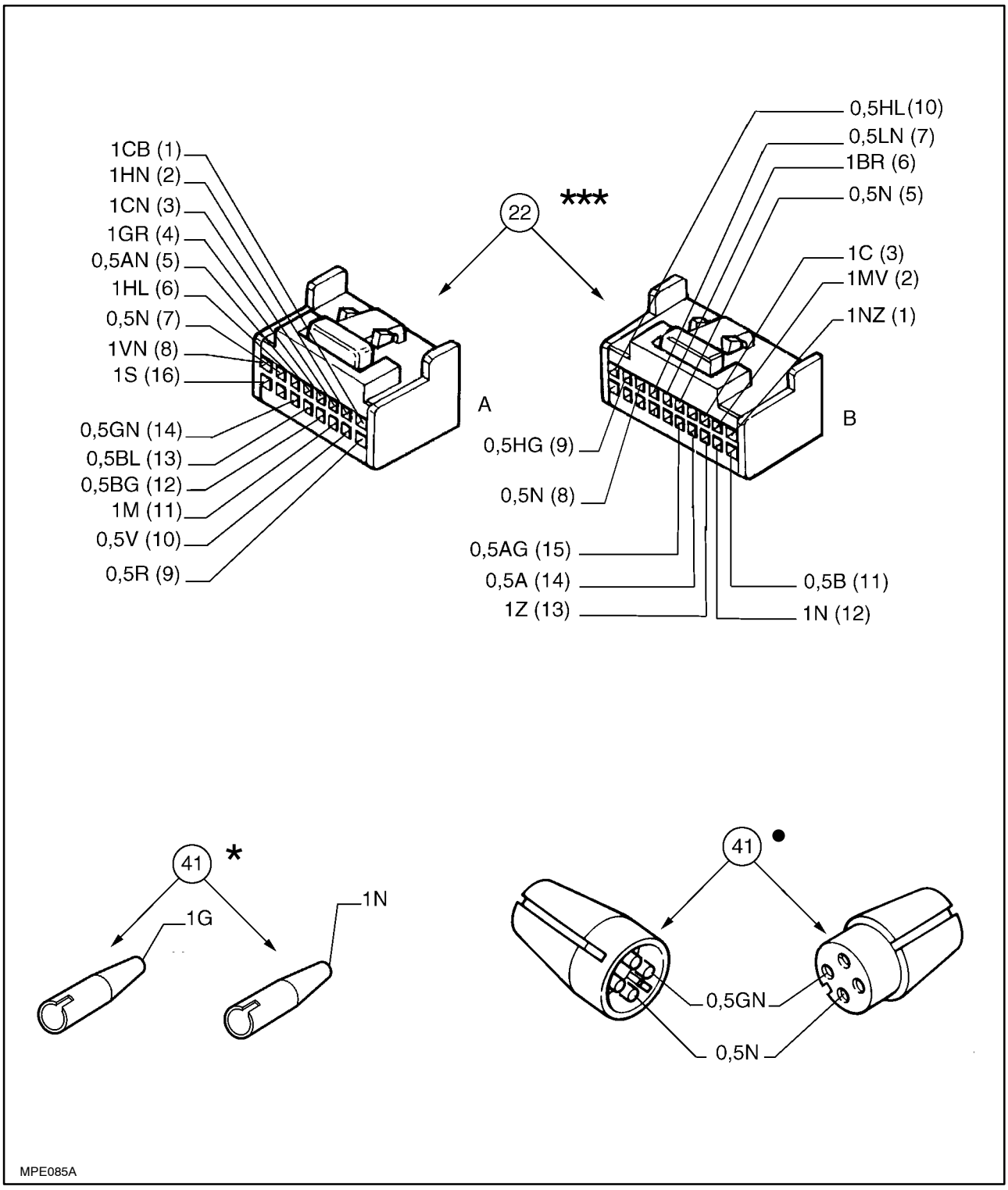
● Version without cab (ISO)



37

▲ Version with Dual Command (2 Speed Power Shift)

** Version without cab

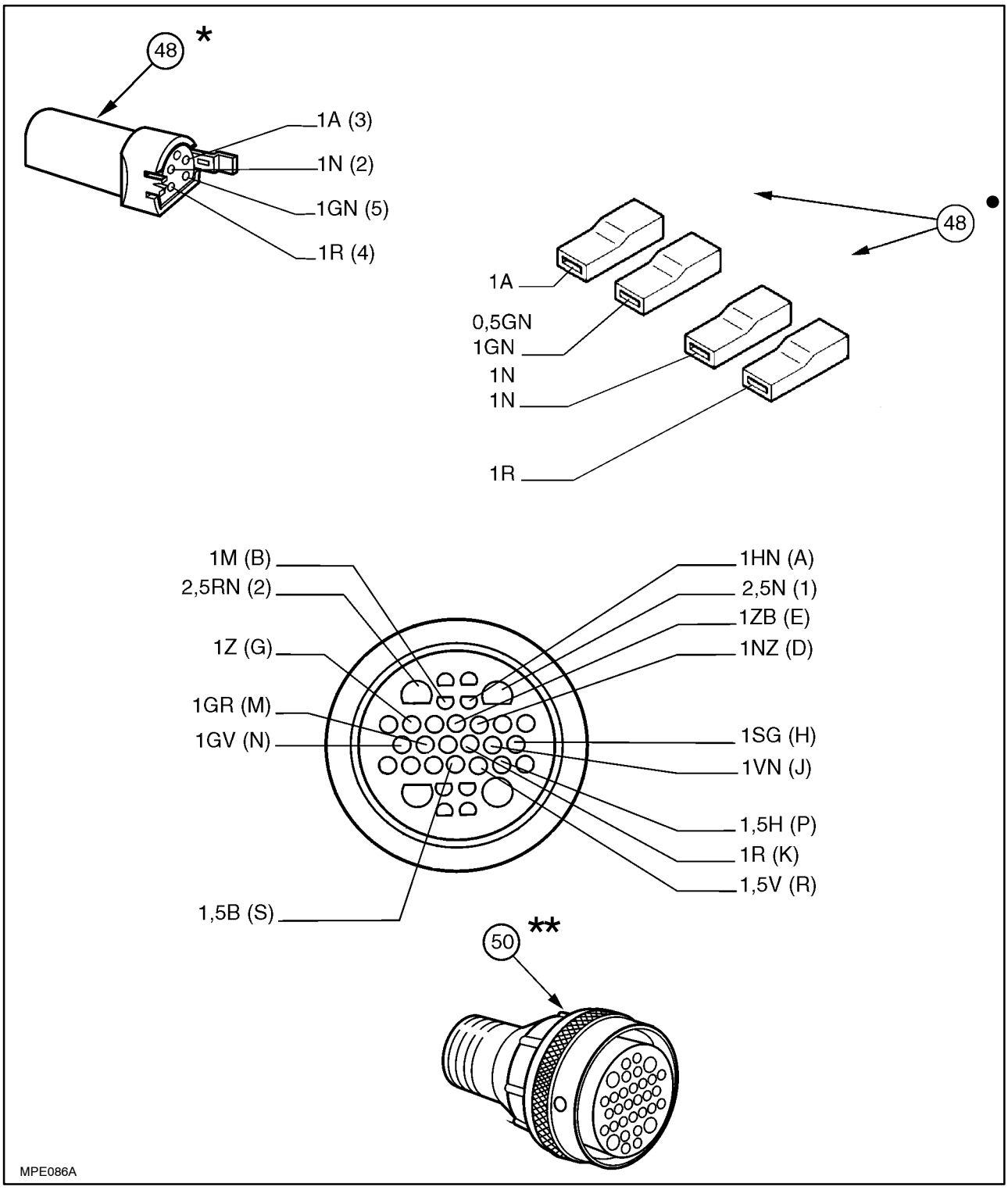


38

* Version with cab

*** Power Shuttle version

● Version without cab (ISO)

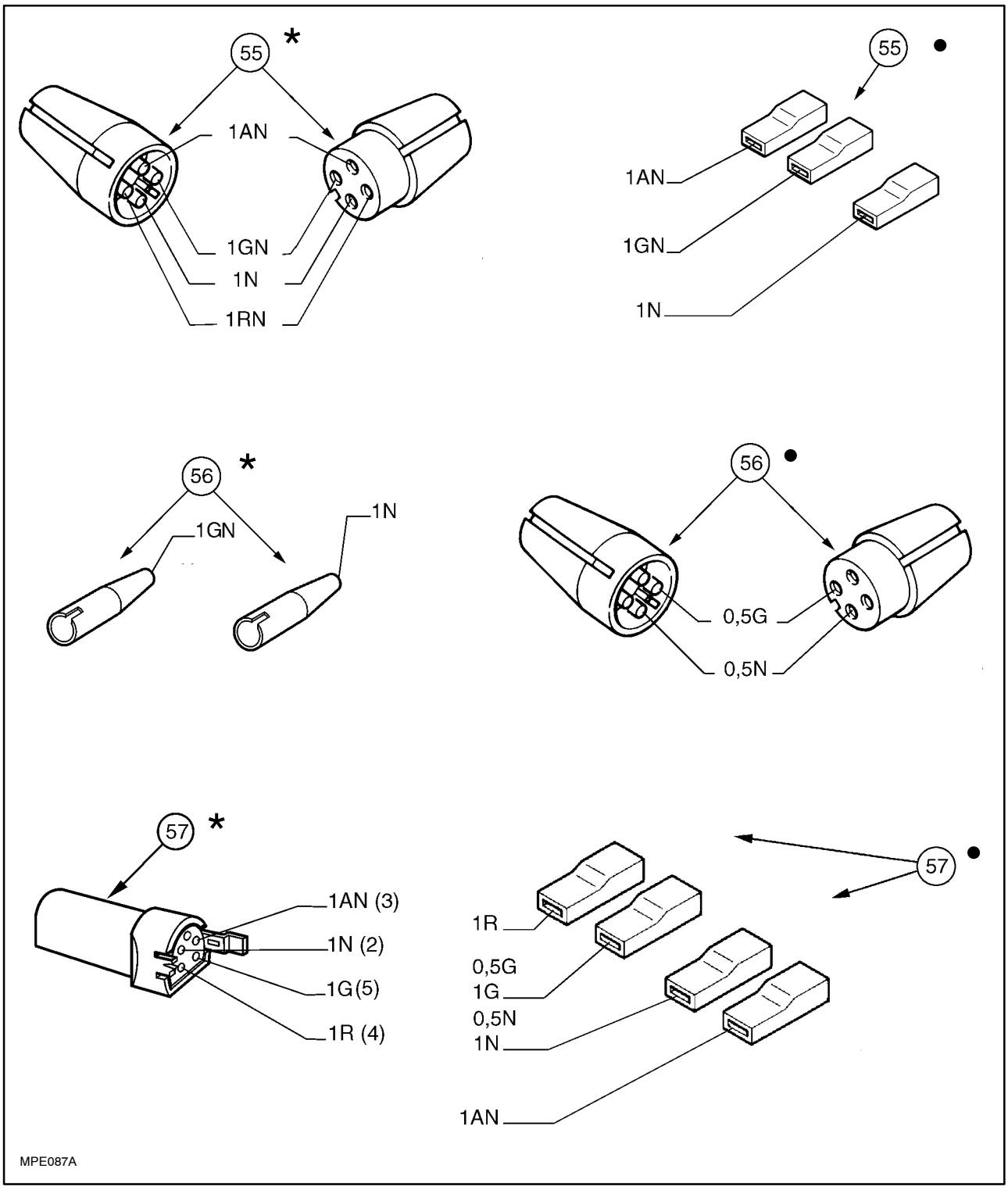


39

• Version without cab (ISO)

* Version with cab

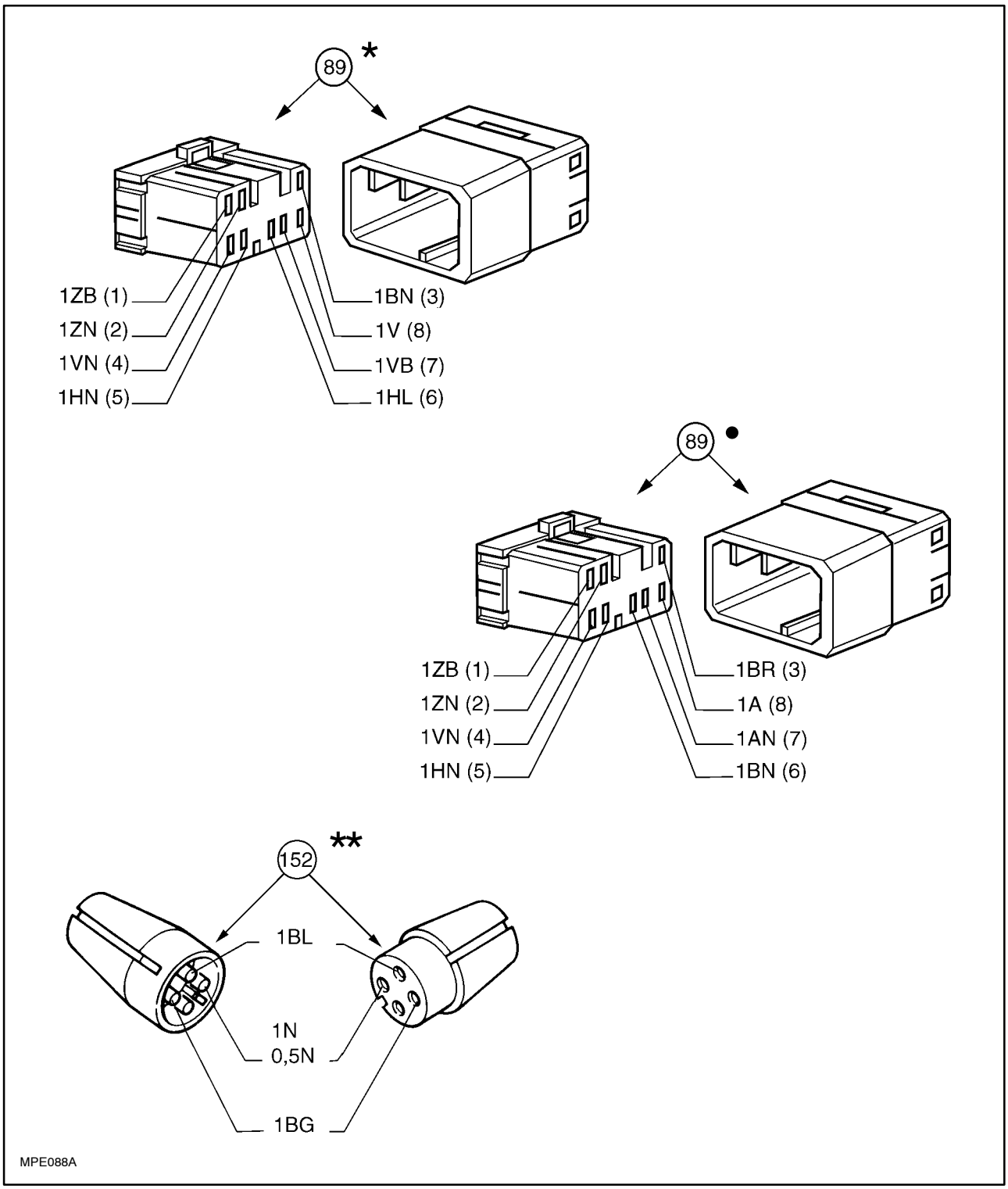
** Version without cab



40

* Version with cab

● Version without cab (ISO)



41

* Version with cab

** Version without cab

● Version without cab (ISO)

SIDE LIGHTS, FULL BEAM, DIPPED BEAM, NUMBER PLATE AND INSTRUMENT LIGHTING CIRCUIT (Version without cab - NASO) (Diagram D)

6 Front LH headlamp

7 Front RH headlamp

14 Front lights connection

15 Fuses and relay control unit

- F3 Front right-hand and left-hand side lights, NASO 7-pole connector
- F4 Front left-hand and rear right-hand side lights, control instrument panel light
- F7 Full beam headlights
- F8 Dipped beam headlights
- F15 Rear work light
- III Full beam headlight circuit
- V Dipped beam headlight circuit
- VI Side lights circuit

22 Instrument panel

- e Side/tail lights
- d Full beam headlights
- r Rear work light
- w Instrument lighting

50 Front main connection (24 PIN)

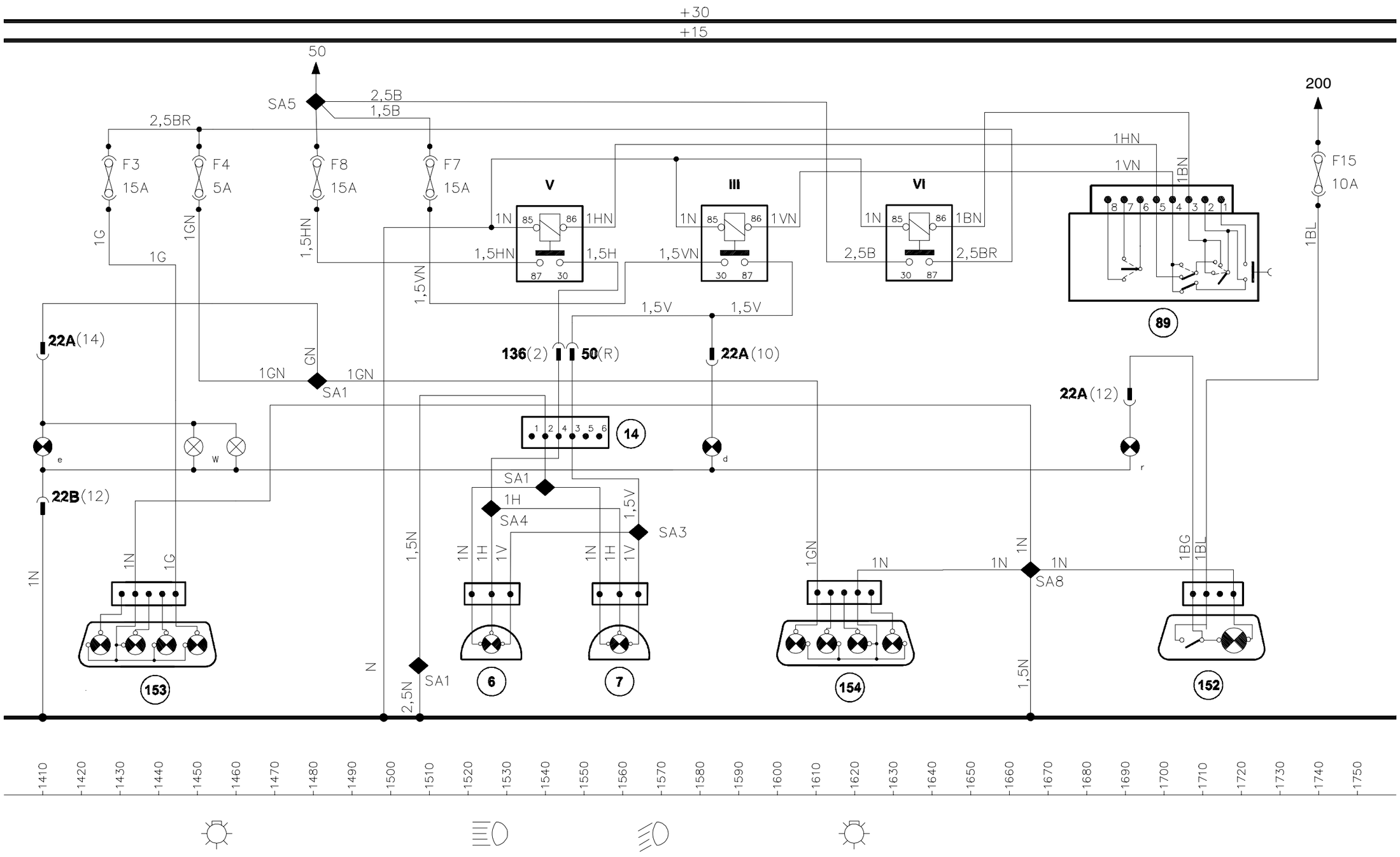
89 External lights control switch

152 Rear work light (version without cab)

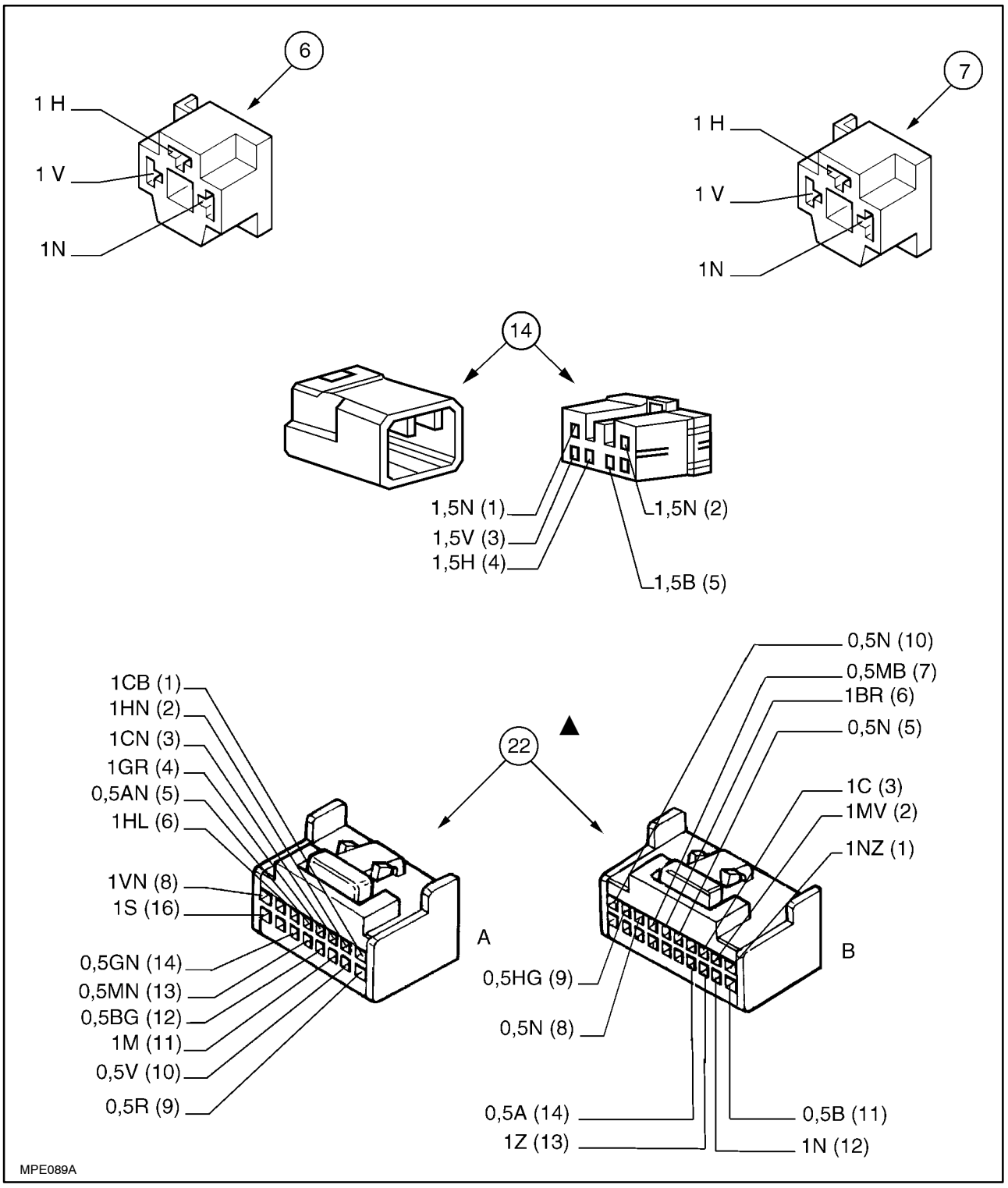
153 LH two-faced headlight (NASO version)

154 RH two-faced headlight (NASO version)

SIDE LIGHTS, FULL BEAM, DIPPED BEAM CIRCUIT, NUMBER PLATE AND INSTRUMENT LIGHTING (Version without cab - NASO) - DIAGRAM D

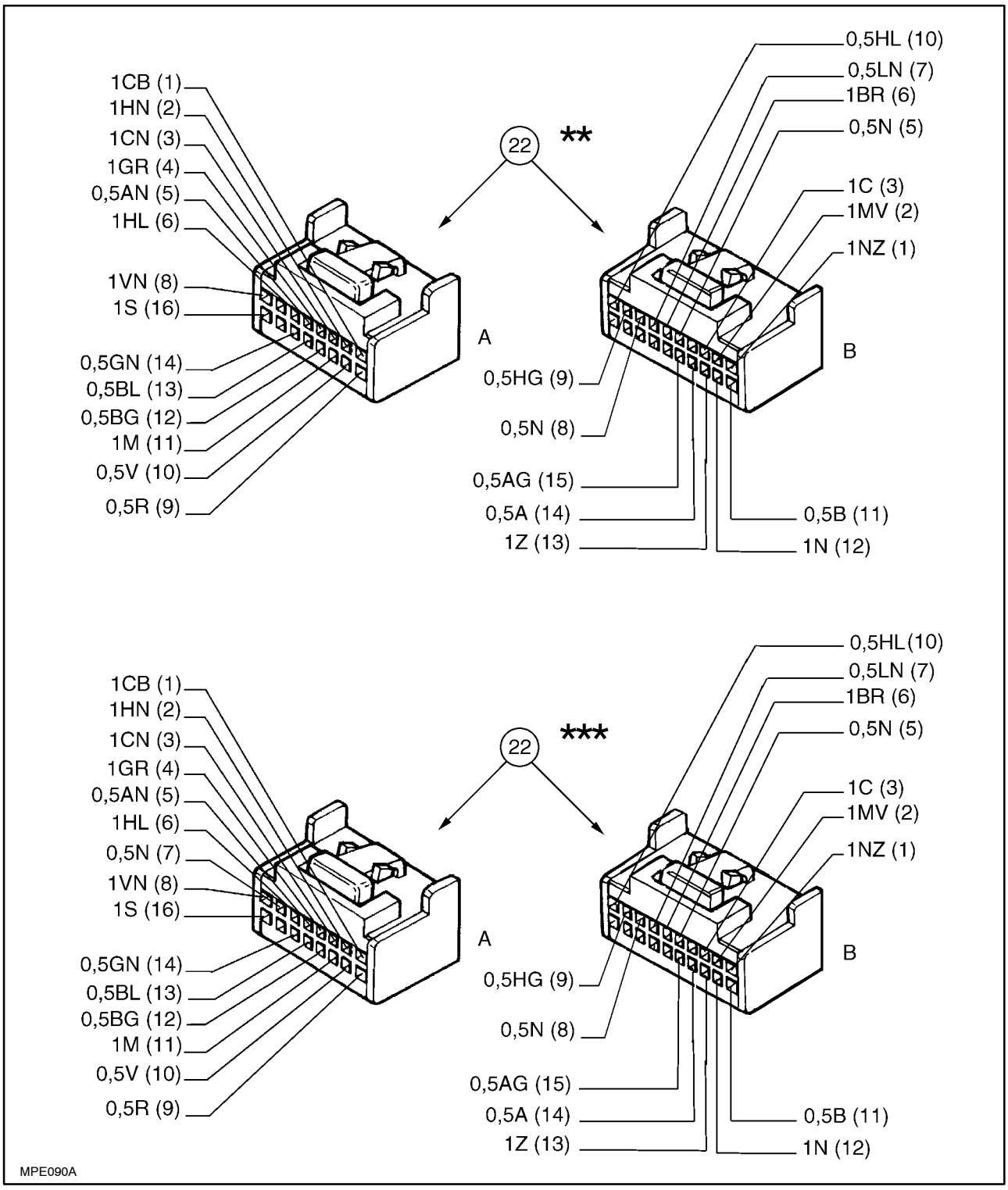


MPD3116A



42

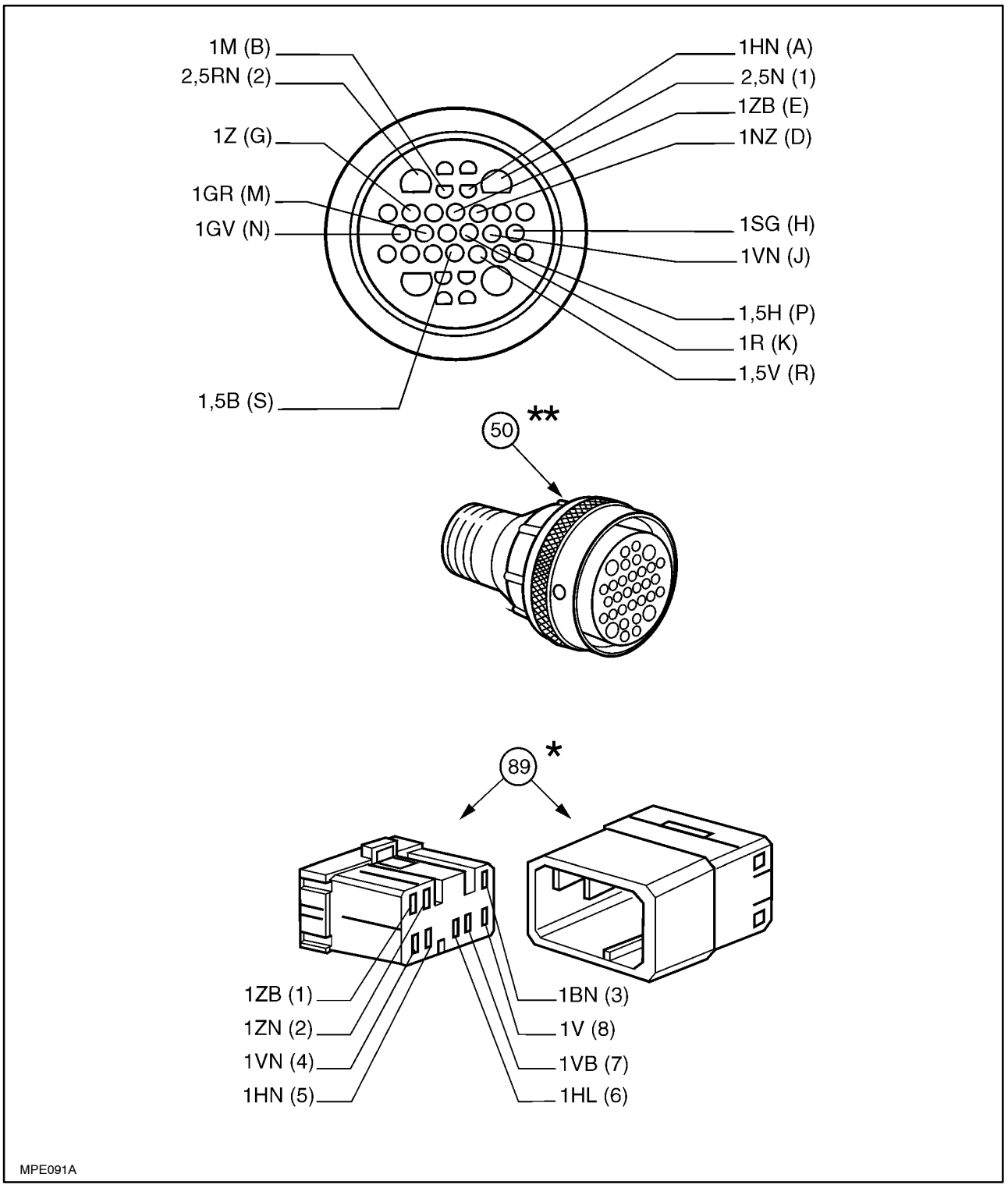
▲ Version with Dual Command (2 Speed Power Shift)



43

** Version without cab

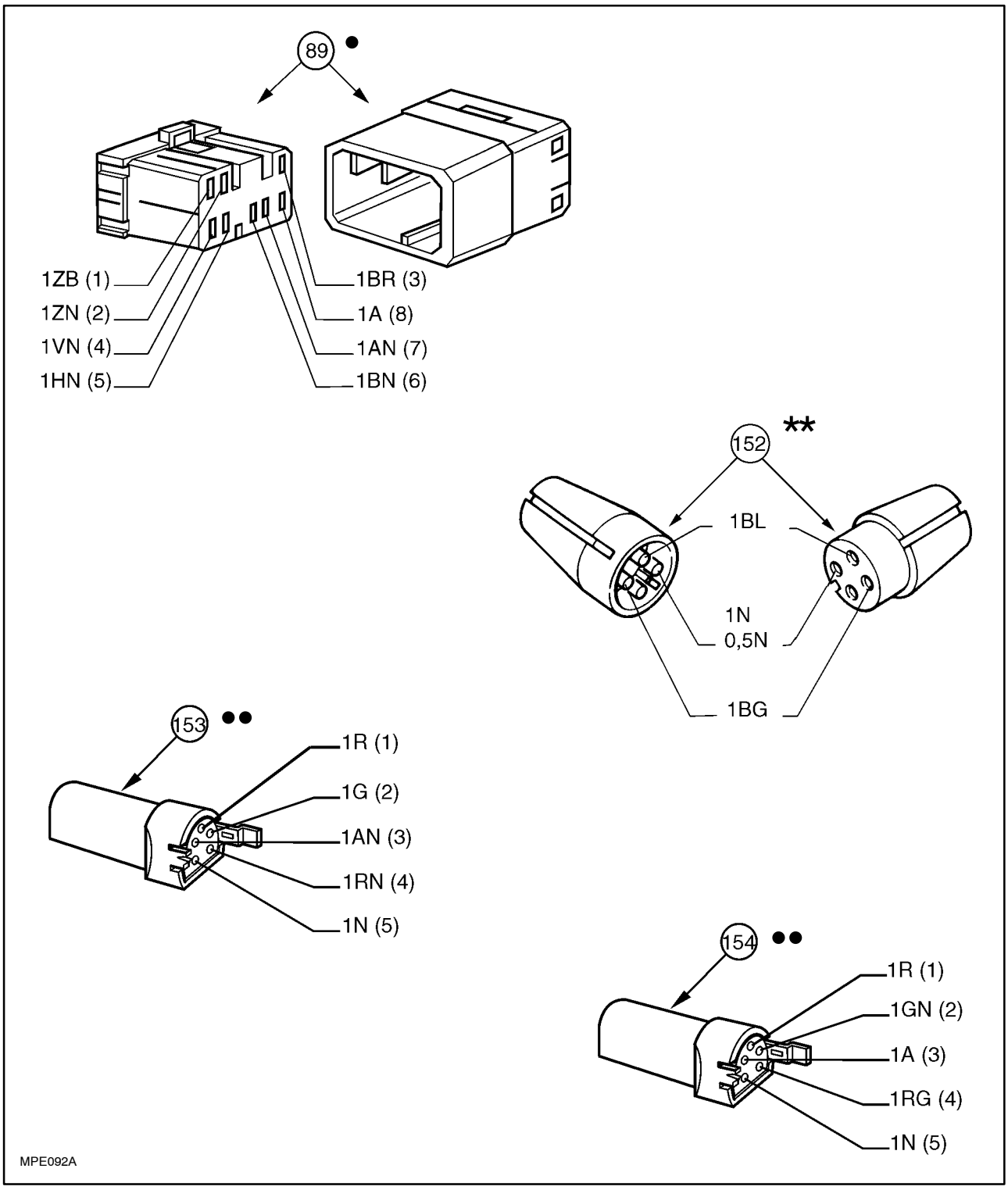
*** Power Shuttle version



44

* Version with cab

** Version without cab



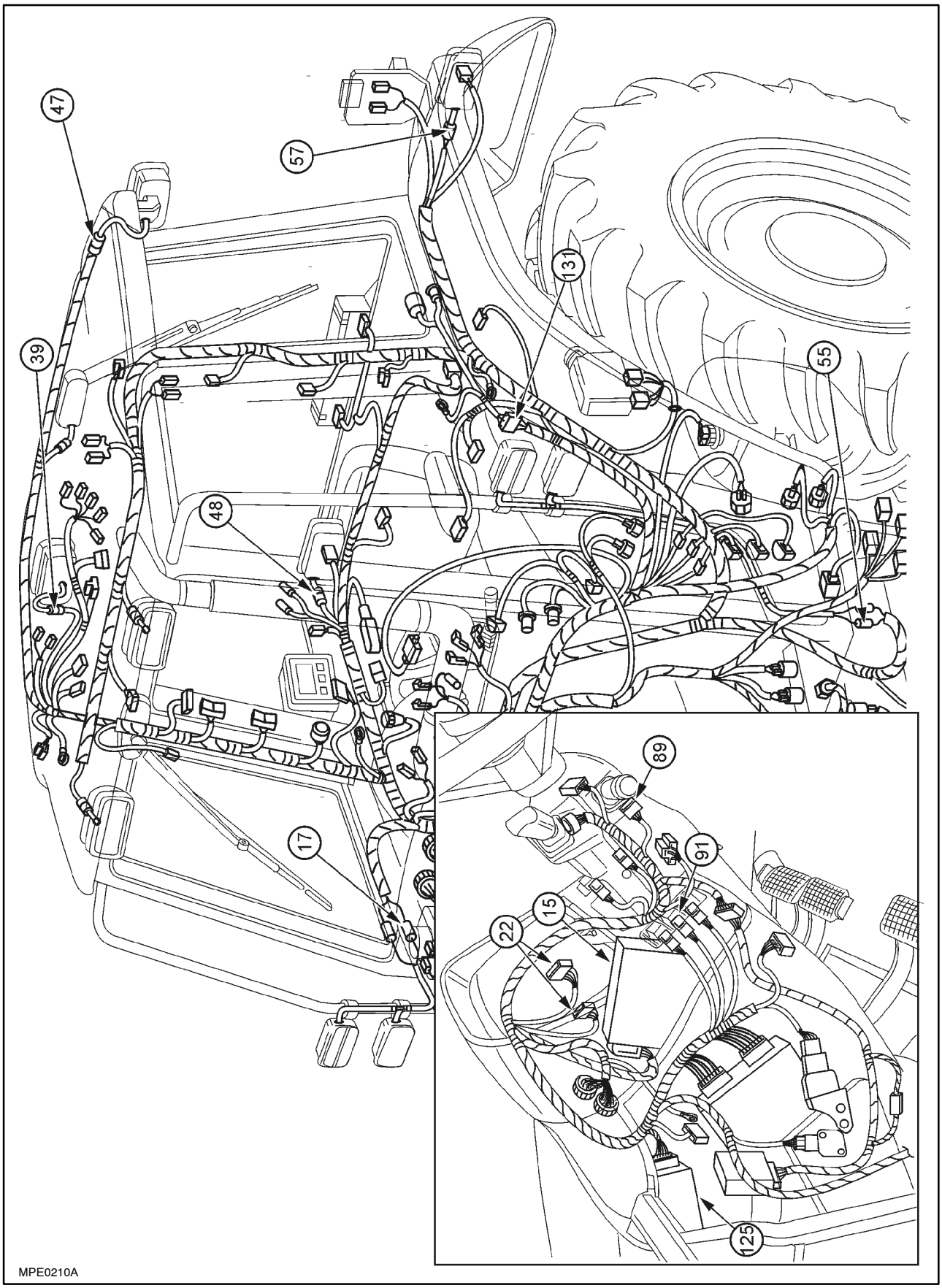
45

** Version without cab

● Version without cab (ISO)

●● Version without cab (NASO)

WIRING DIAGRAM E



DIRECTION INDICATOR AND HAZARD LIGHTS CIRCUIT (Version with cab) (Diagram E)

15 Fuses and relay control unit
- F10 Direction indicator and hazard lights
- F12 Trailer brake circuit, instruments, seat safety circuit

17 Side lights and RH front direction indicator

22 Instrument panel
- a Left-hand direction indicator
- b First trailer direction indicator
- c Second trailer direction indicator
- m Right-hand direction indicator

39 Connection for auxiliary work light and RH rear extra direction indicator

47 Connection for auxiliary work light and LH rear extra direction indicator

48 RH tail light

55 LH front direction indicator and side light

57 LH tail light

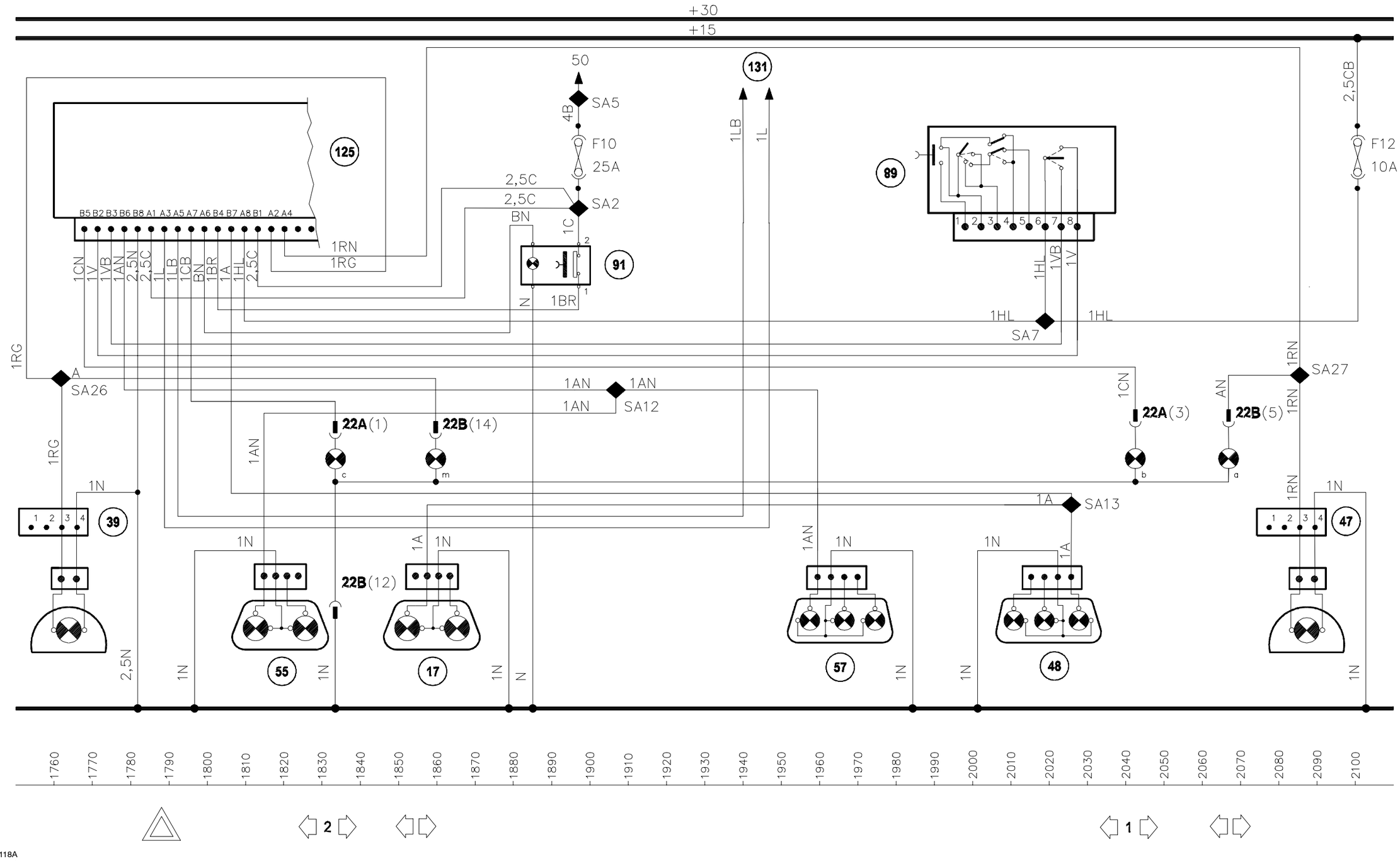
89 External lights control switch

91 Hazard lights switch

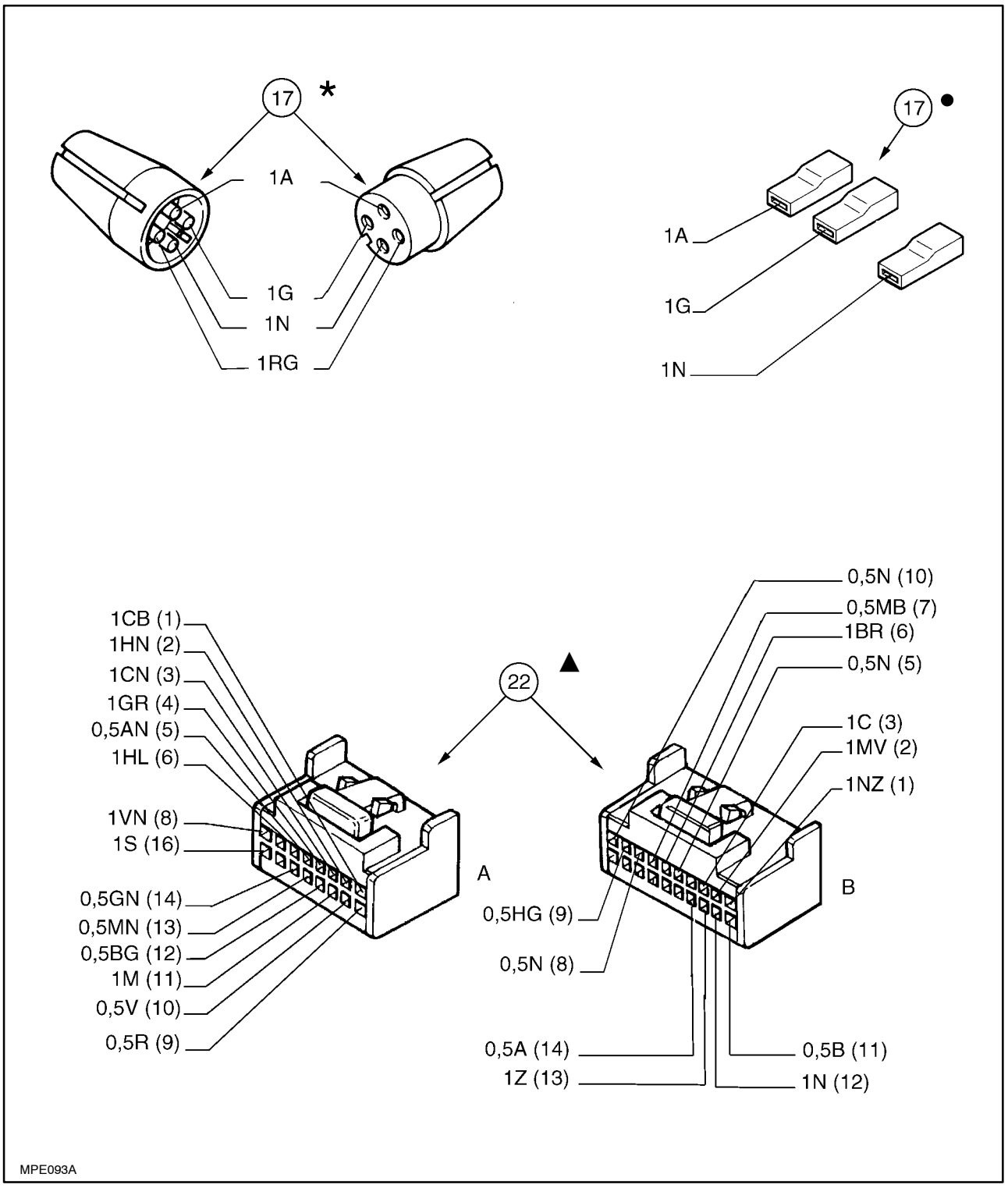
125 Electronic flasher

131 Connection for 7-pole connector

DIRECTION INDICATOR AND HAZARD LIGHTS CIRCUIT (Version with cab) - DIAGRAM E



MPD3118A

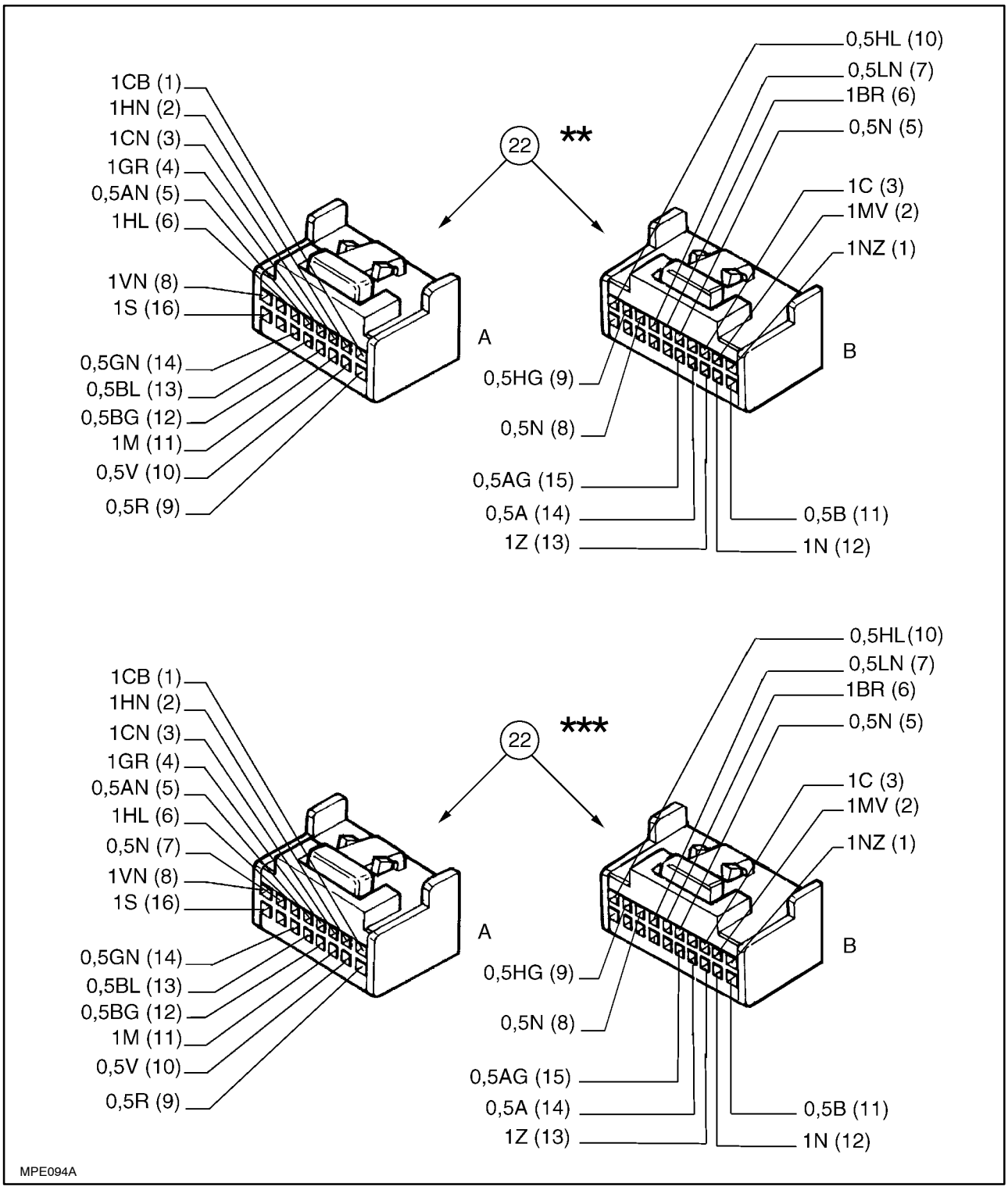


47

* Version with cab

● Version without cab (ISO)

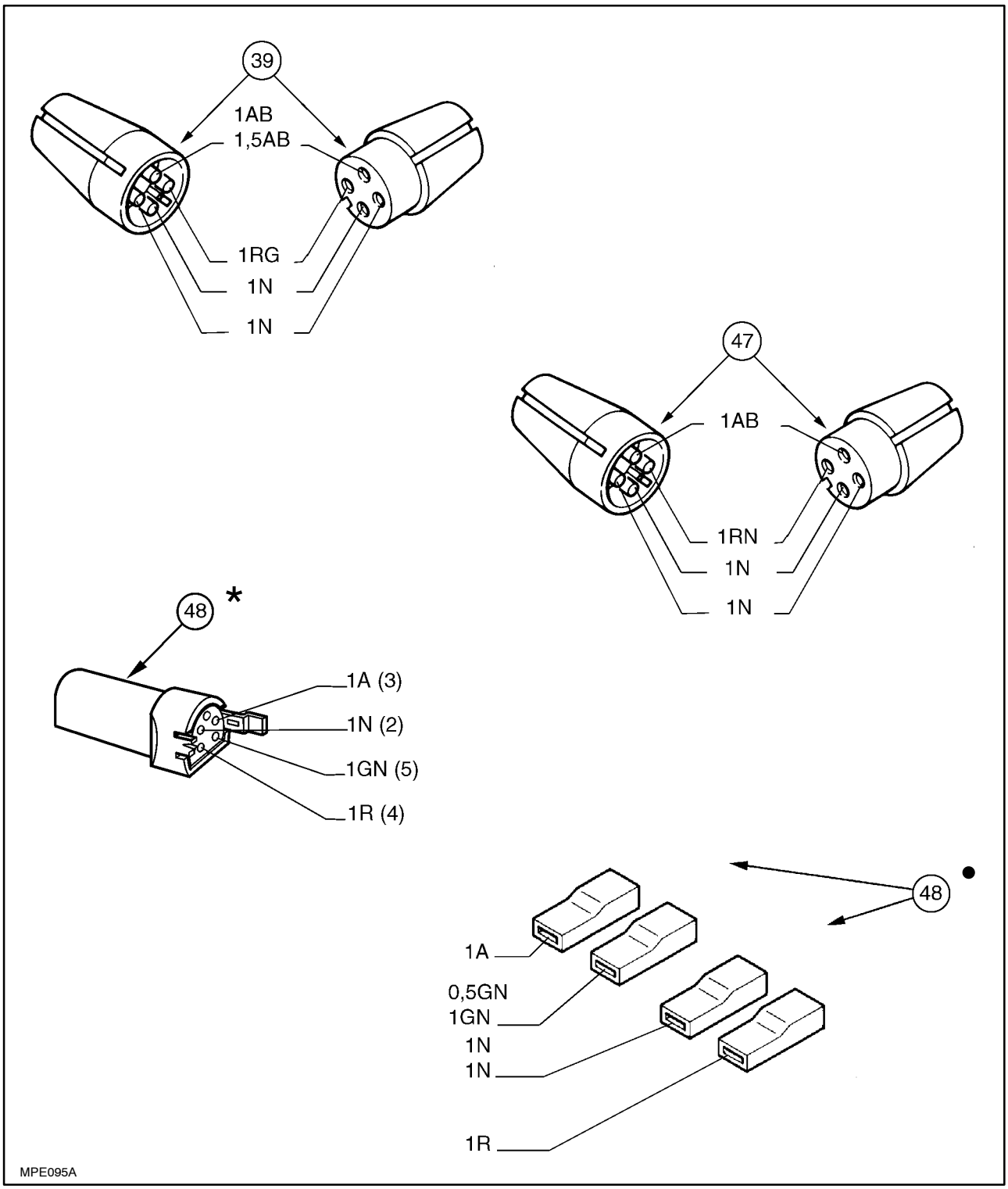
▲ Version with Dual Command (2 Speed Power Shift)



48

** Version without cab

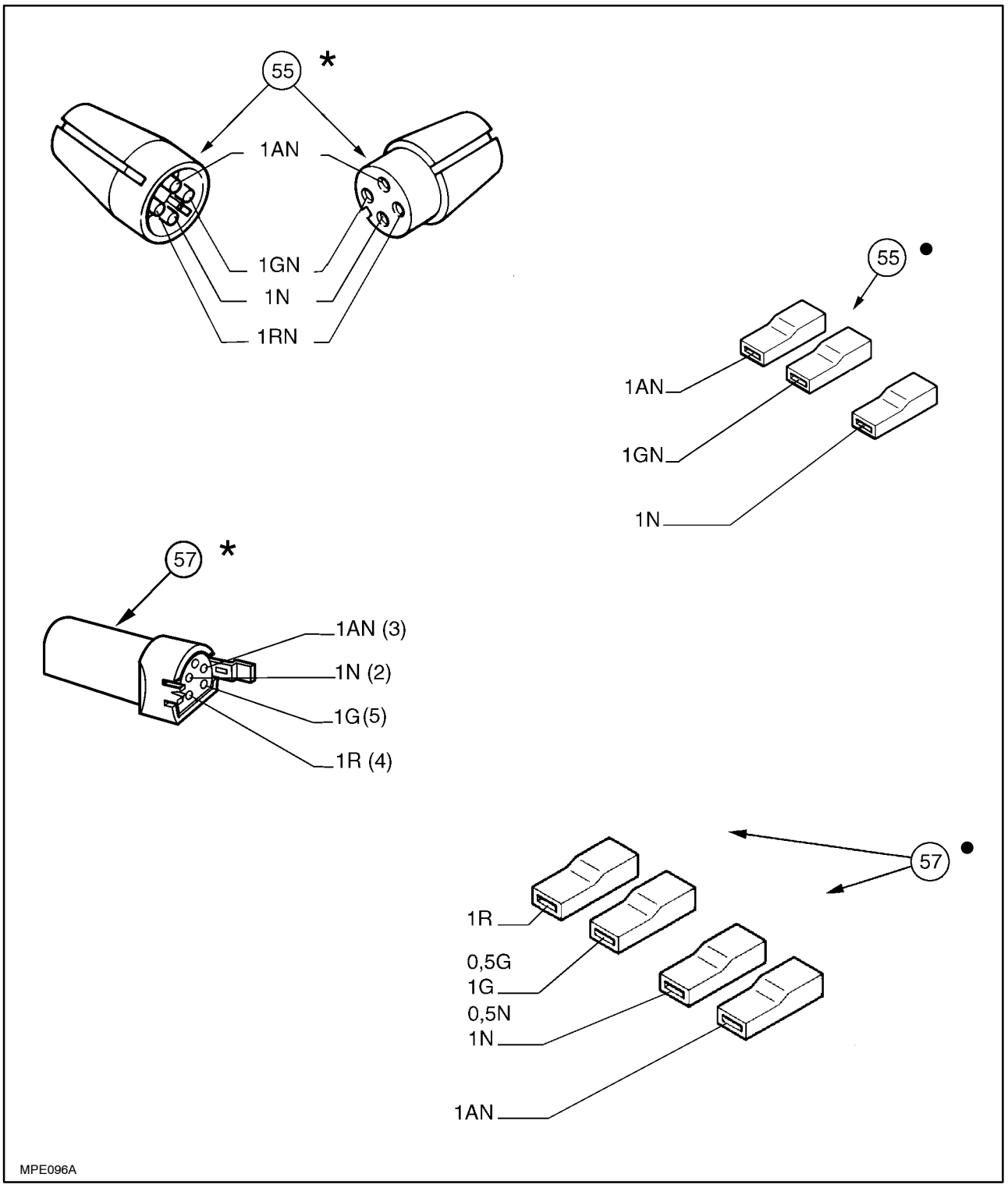
*** Power Shuttle version



49

* Version with cab

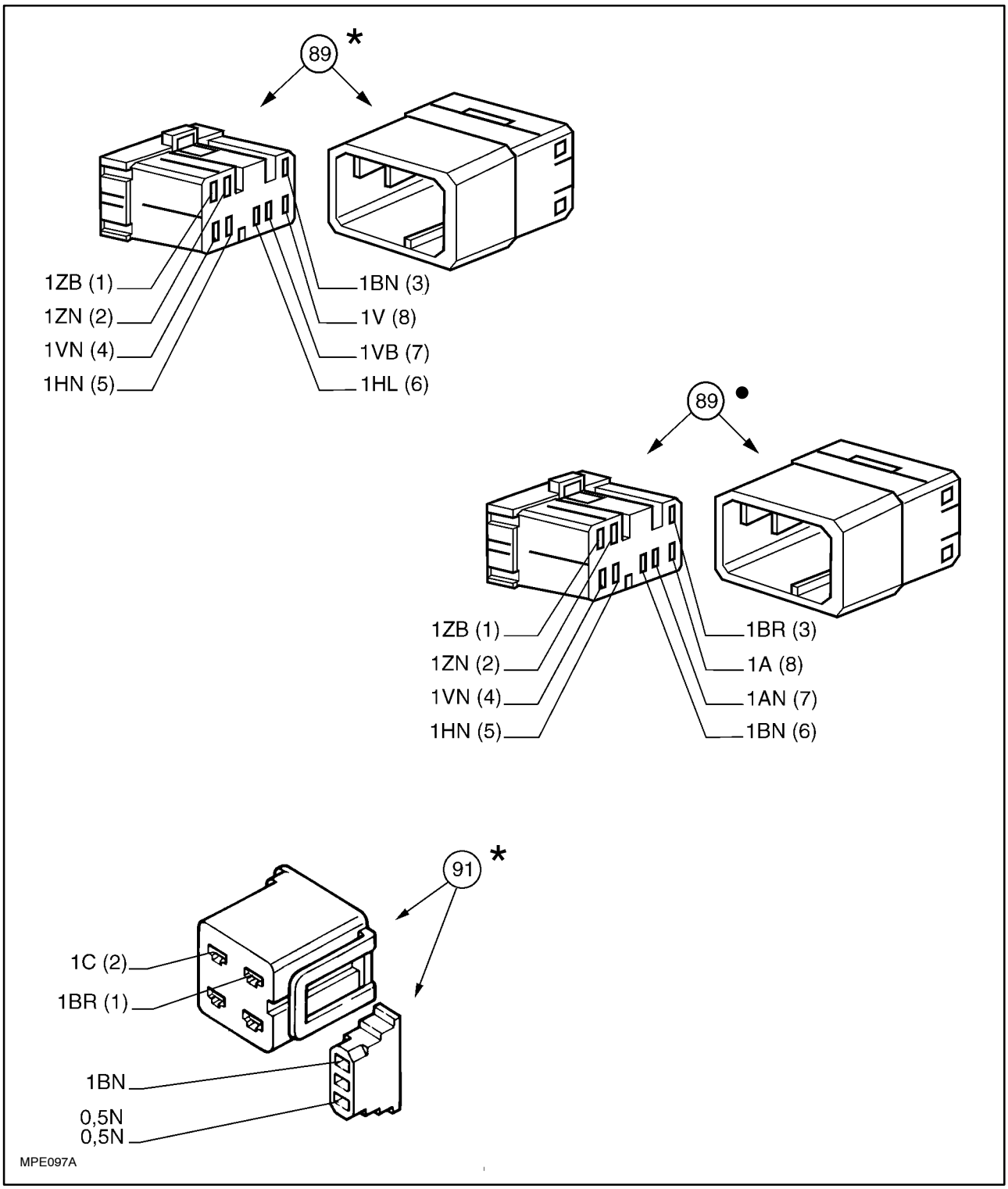
• Version without cab (ISO)



50

* Version with cab

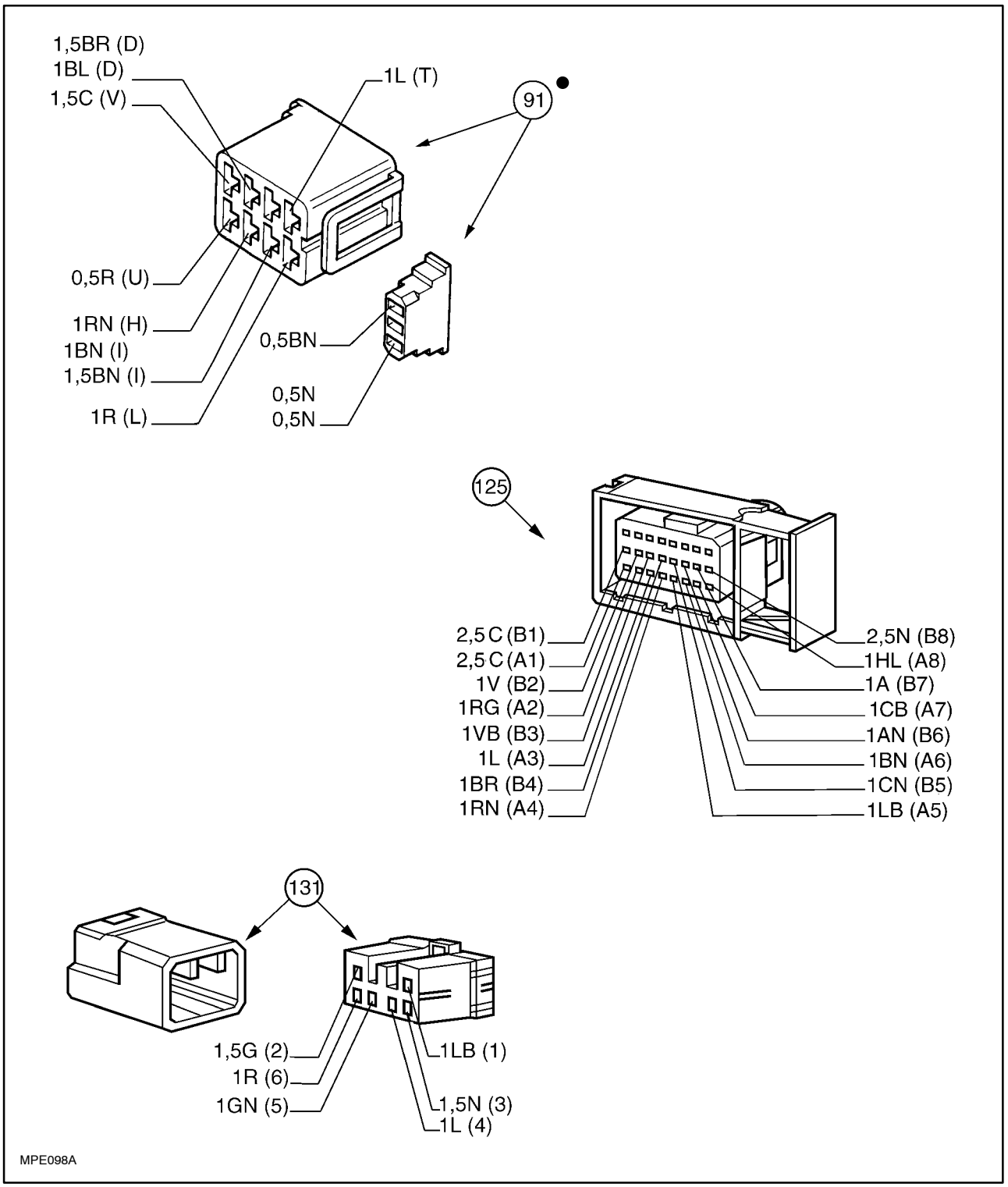
● Version without cab (ISO)



51

* Version with cab

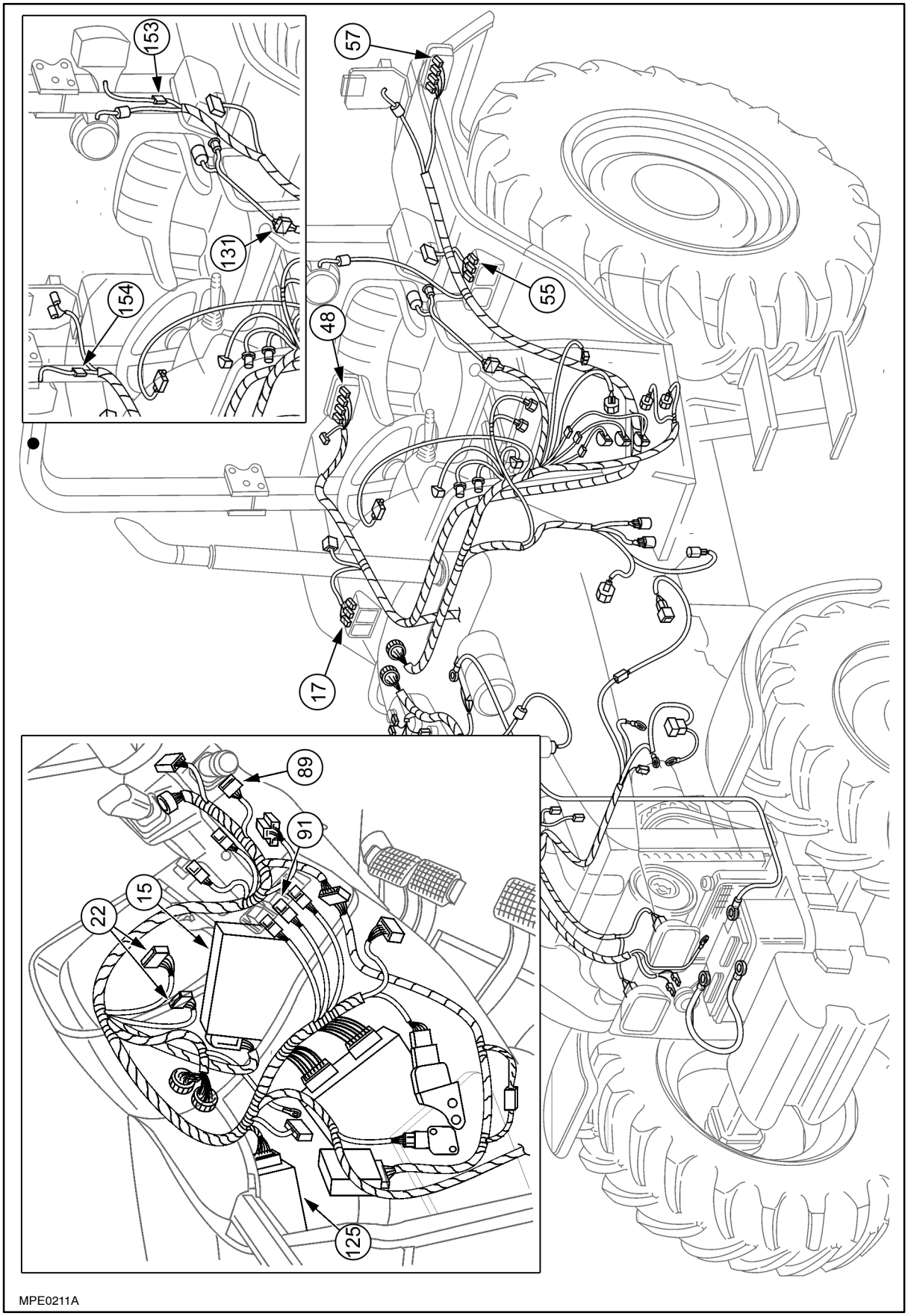
• Version without cab (ISO)



52

- Version without cab (ISO)

WIRING DIAGRAMS F - G



53

DIRECTION INDICATOR AND HAZARD LIGHTS CIRCUIT (Version without cab - NASO) (Diagram F)

15 Fuses and relay control unit
- F10 Direction indicator and hazard lights
- F12 Instruments, seat safety circuit

22 Instrument panel
- a Left-hand direction indicator
- b First trailer direction indicator
- c Second trailer direction indicator
- m Right-hand direction indicator

89 External lights control switch

91 Hazard lights switch

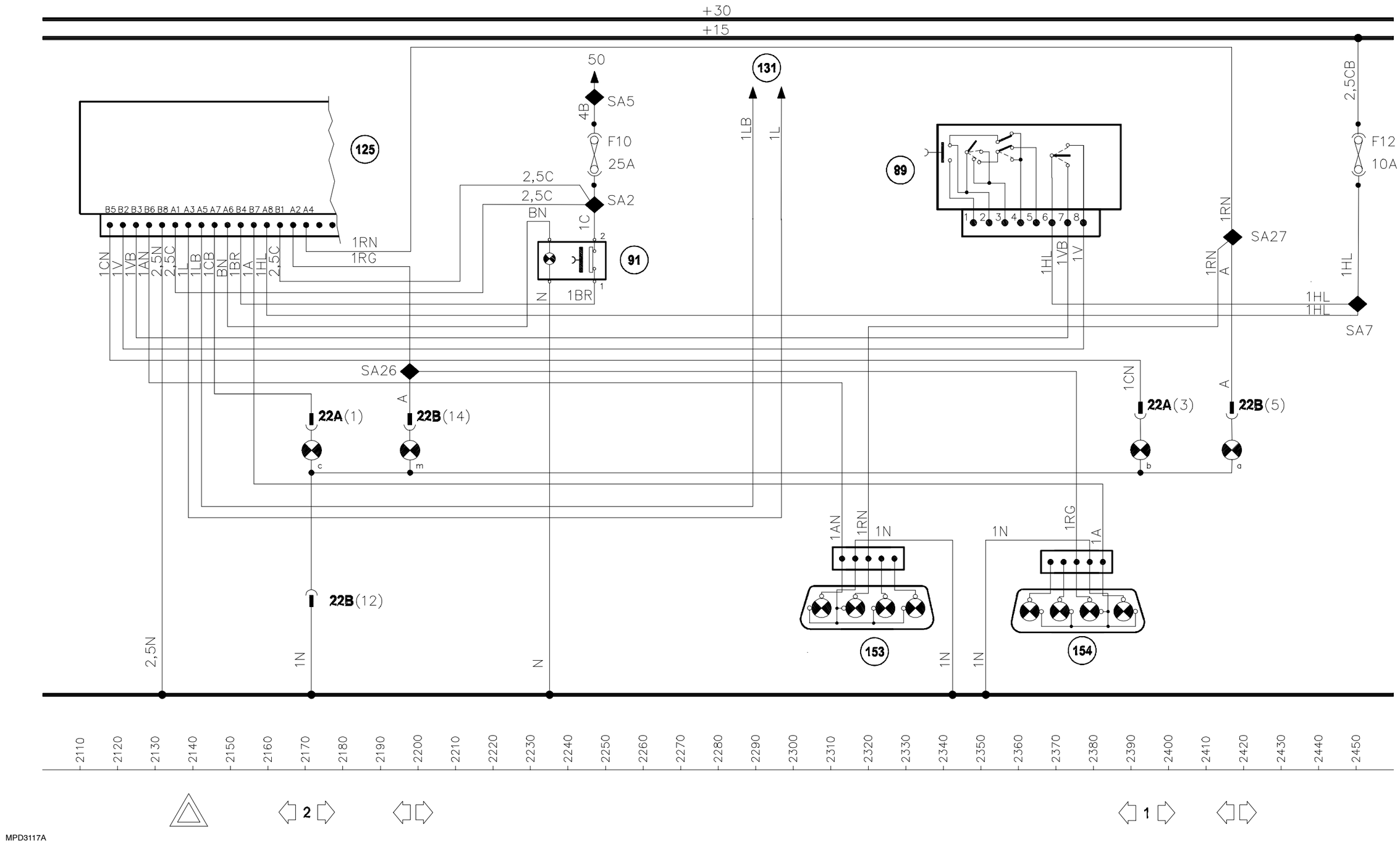
125 Electronic flasher

131 Connection for 7-pole connector

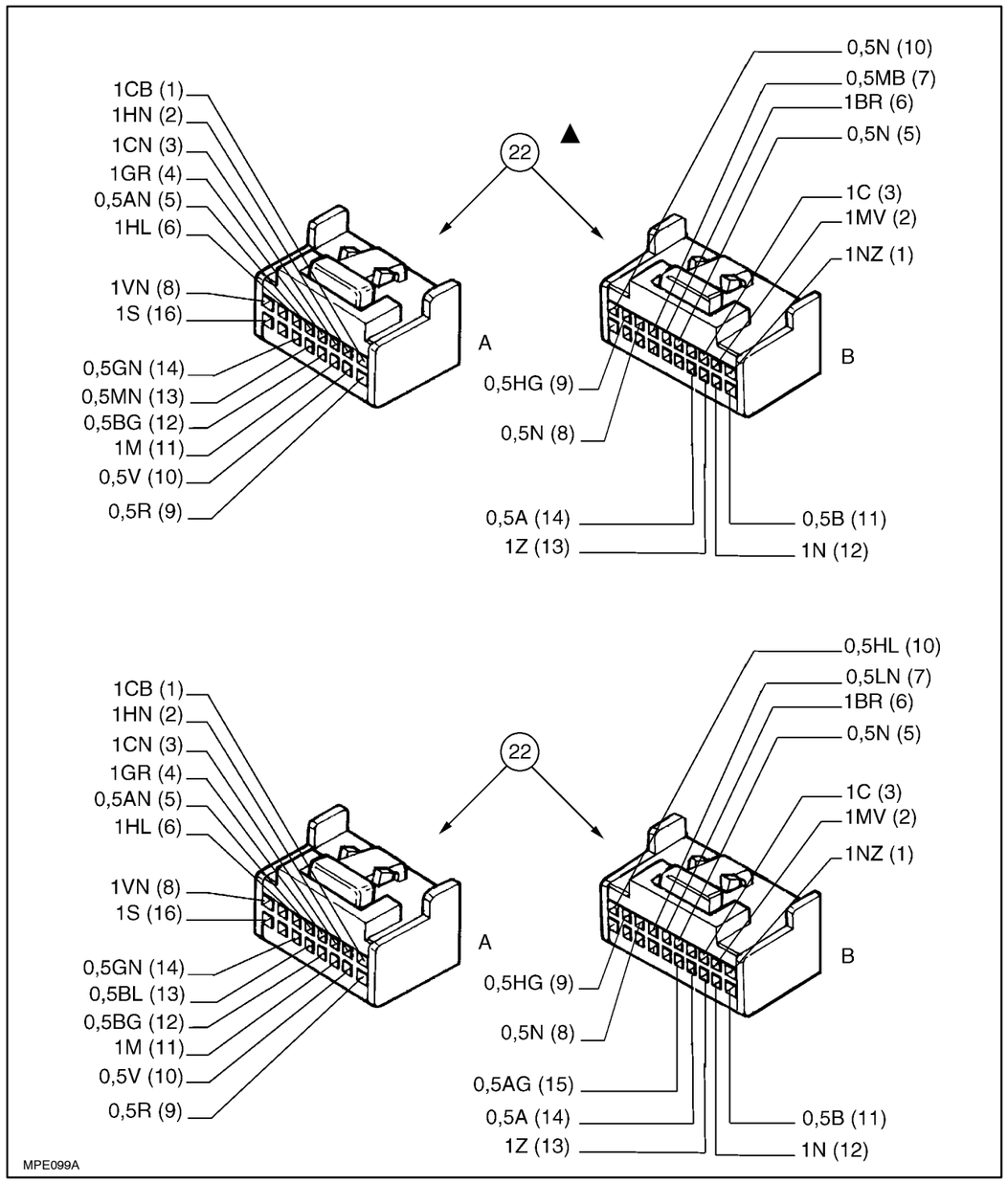
153 LH two-faced headlight (NASO version)

154 RH two-faced headlight (NASO version)

DIRECTION INDICATOR AND HAZARD LIGHTS CIRCUIT (Version without cab - NASO) - DIAGRAM F

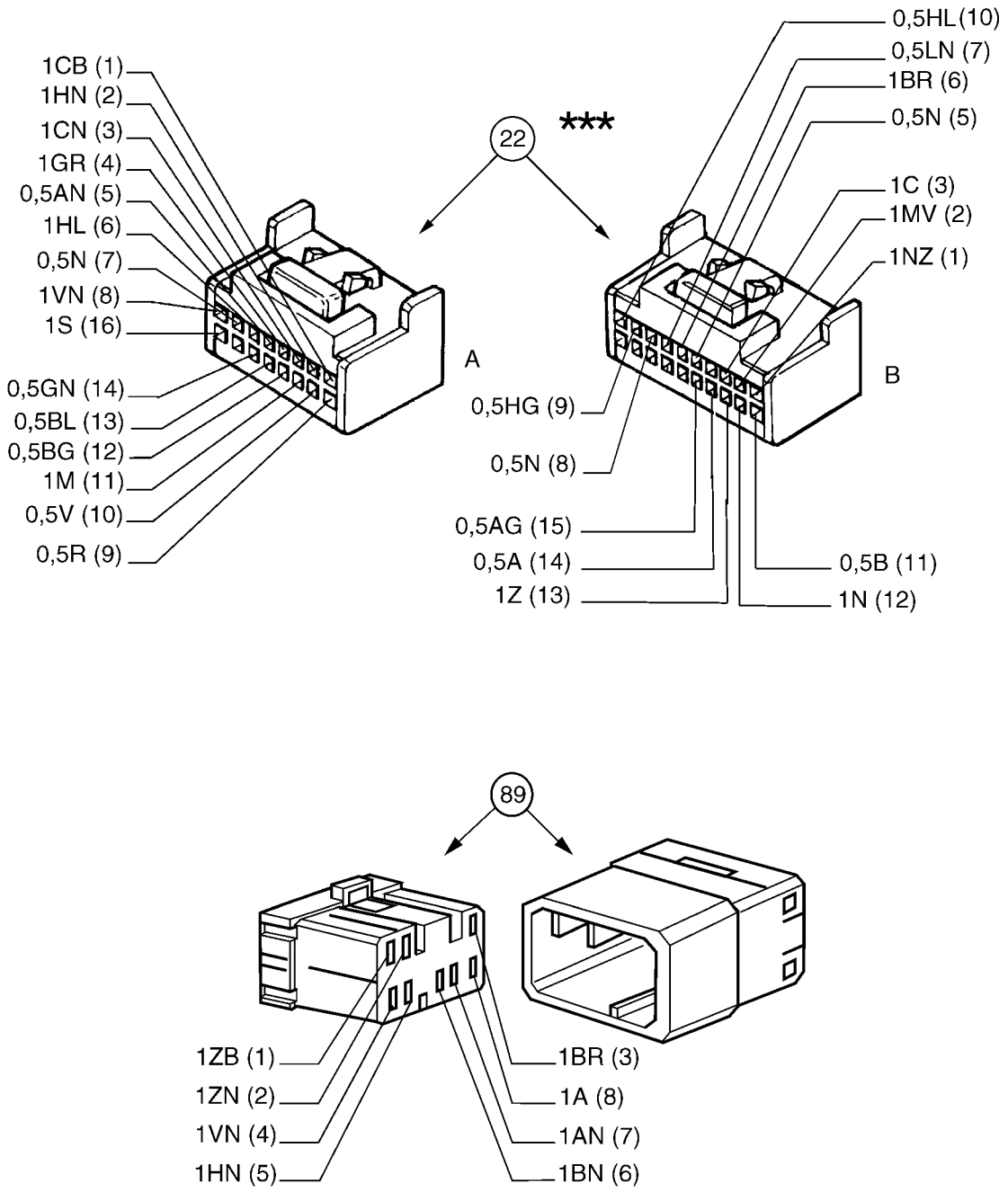


MPD3117A



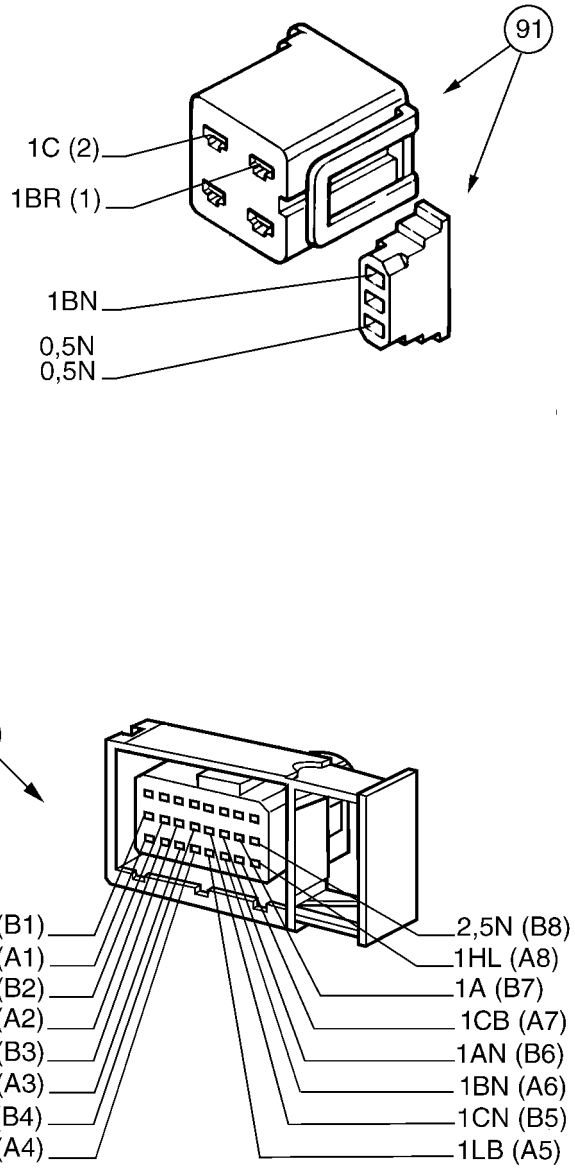
54

▲ Version with Dual Command (2 Speed Power Shift)



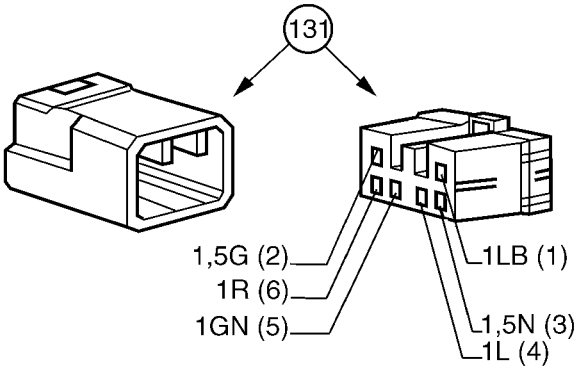
55

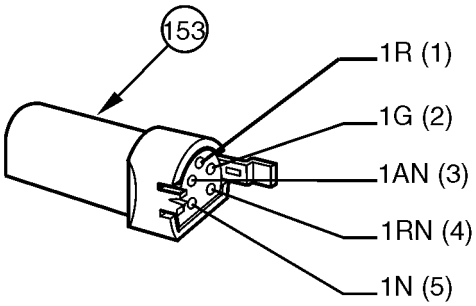
*** Power Shuttle version

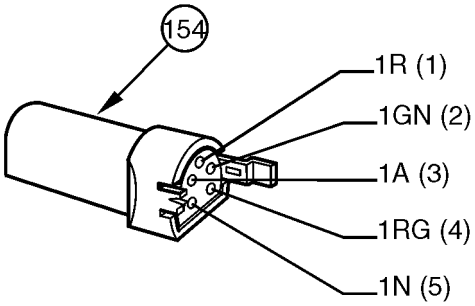

91
1C (2)
1BR (1)
1BN
0,5N
0,5N
125
2,5 C (B1)
2,5 C (A1)
1V (B2)
1RG (A2)
1VB (B3)
1L (A3)
1BR (B4)
1RN (A4)
2,5N (B8)
1HL (A8)
1A (B7)
1CB (A7)
1AN (B6)
1BN (A6)
1CN (B5)
1LB (A5)

MPE0101A

56


131
1,5G (2)
1R (6)
1GN (5)
1LB (1)
1,5N (3)
1L (4)


153
1R (1)
1G (2)
1AN (3)
1RN (4)
1N (5)


154
1R (1)
1GN (2)
1A (3)
1RG (4)
1N (5)

MPE0102A

57

DIRECTION INDICATOR AND HAZARD LIGHTS CIRCUIT (Version without cab - ISO) (Diagram G)

15 Fuses and relay control unit
- F10 Direction indicator and hazard lights
- F20 Direction indicators
- VI Electronic flasher

17 RH front direction indicator and side light

22 Instrument panel
- a Left-hand direction indicator
- b First trailer direction indicator
- c Second trailer direction indicator
- m Right-hand direction indicator

48 RH tail light

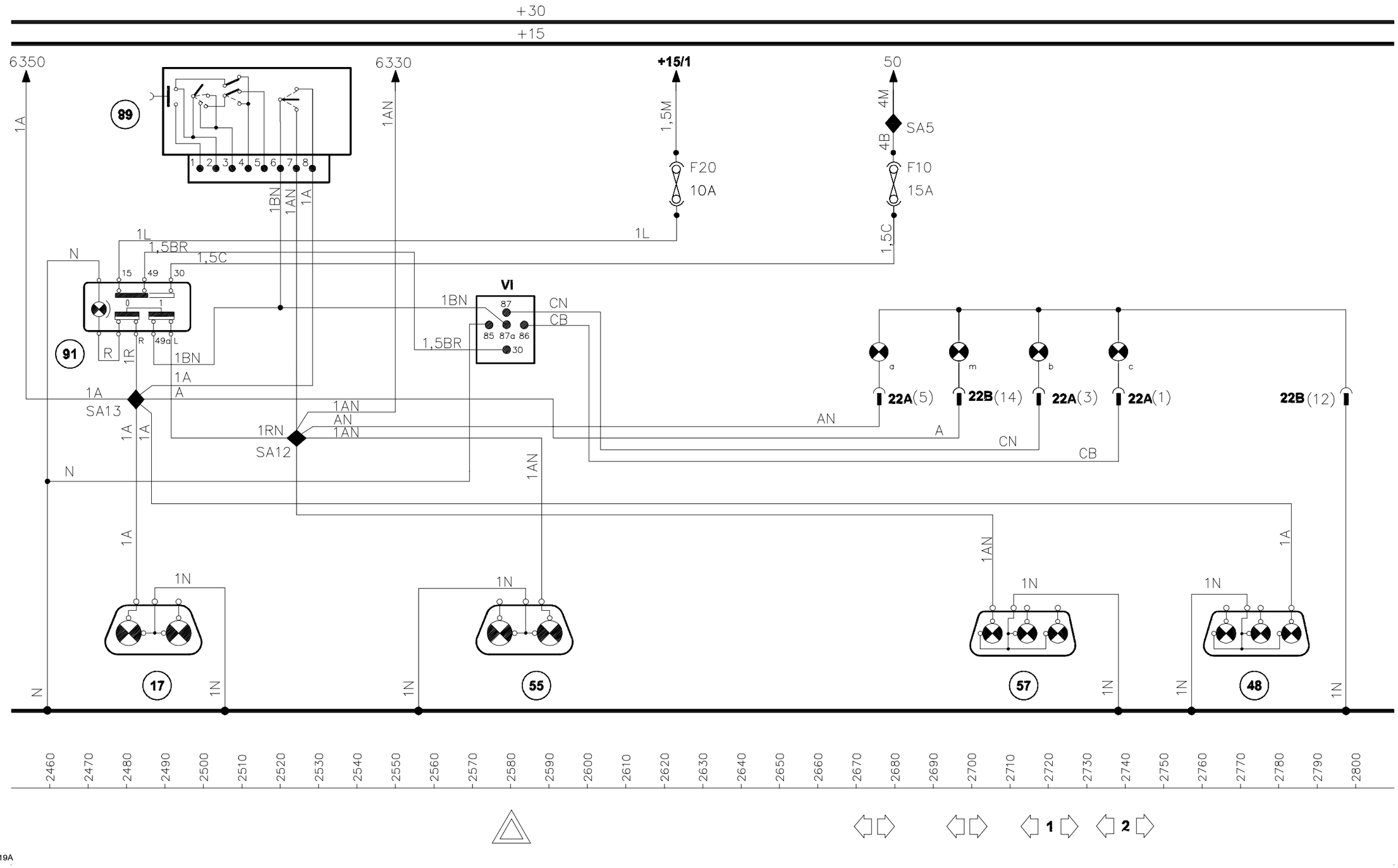
55 LH front direction indicator and side light

57 LH tail light

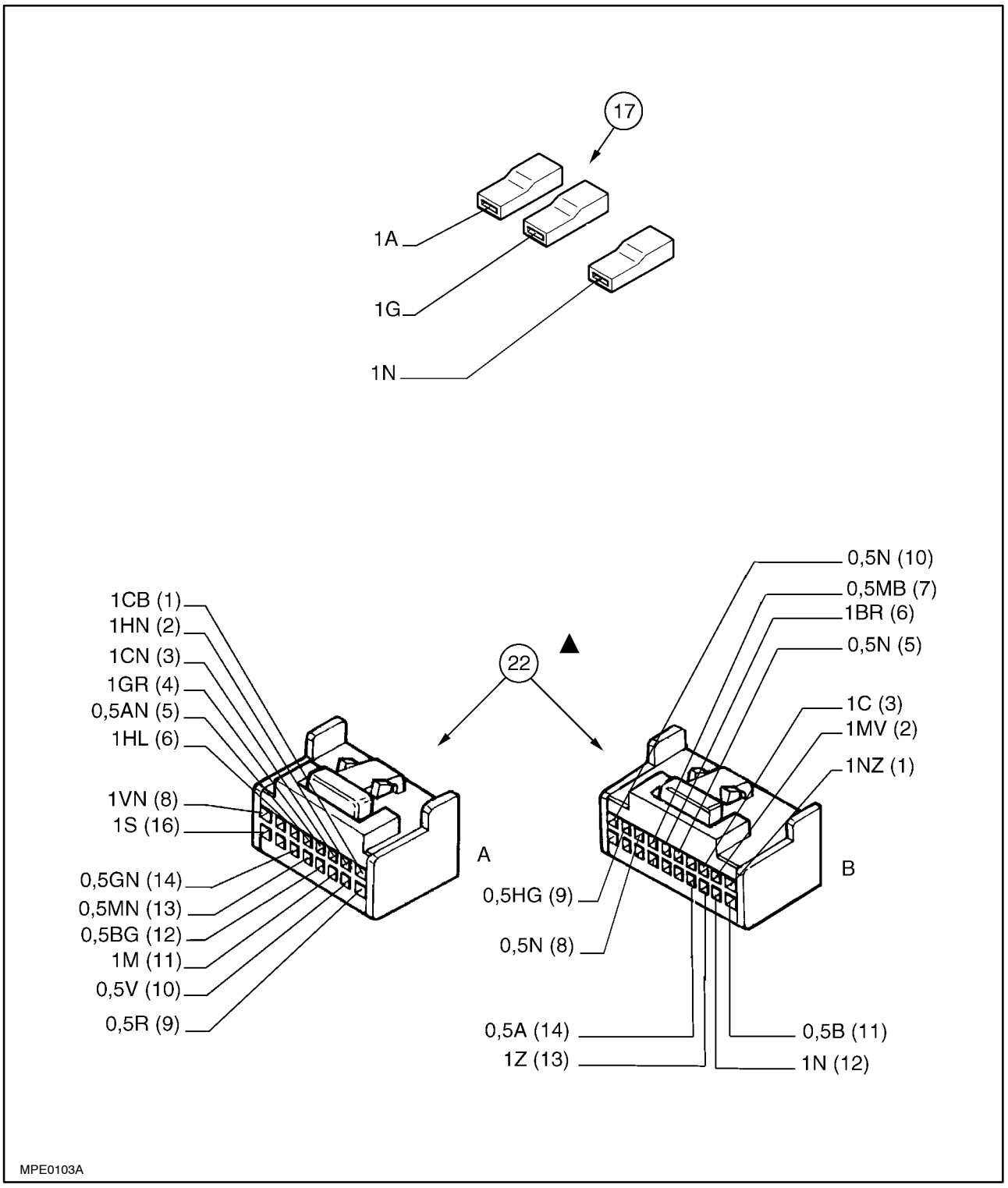
89 External lights control switch

91 Hazard lights switch

DIRECTION INDICATOR AND HAZARD LIGHTS CIRCUIT (Version without cab - ISO) - DIAGRAM G

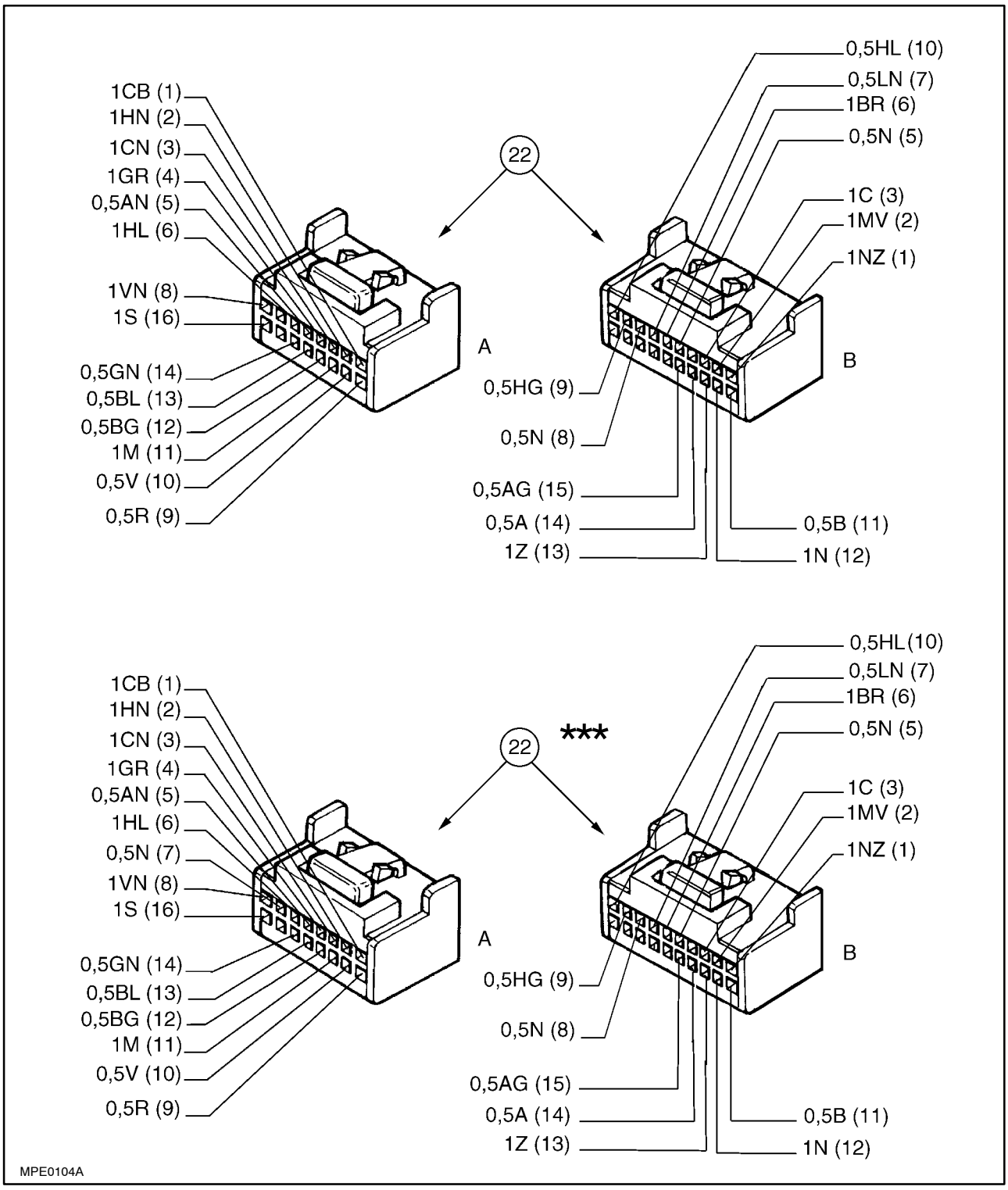


MPD3119A



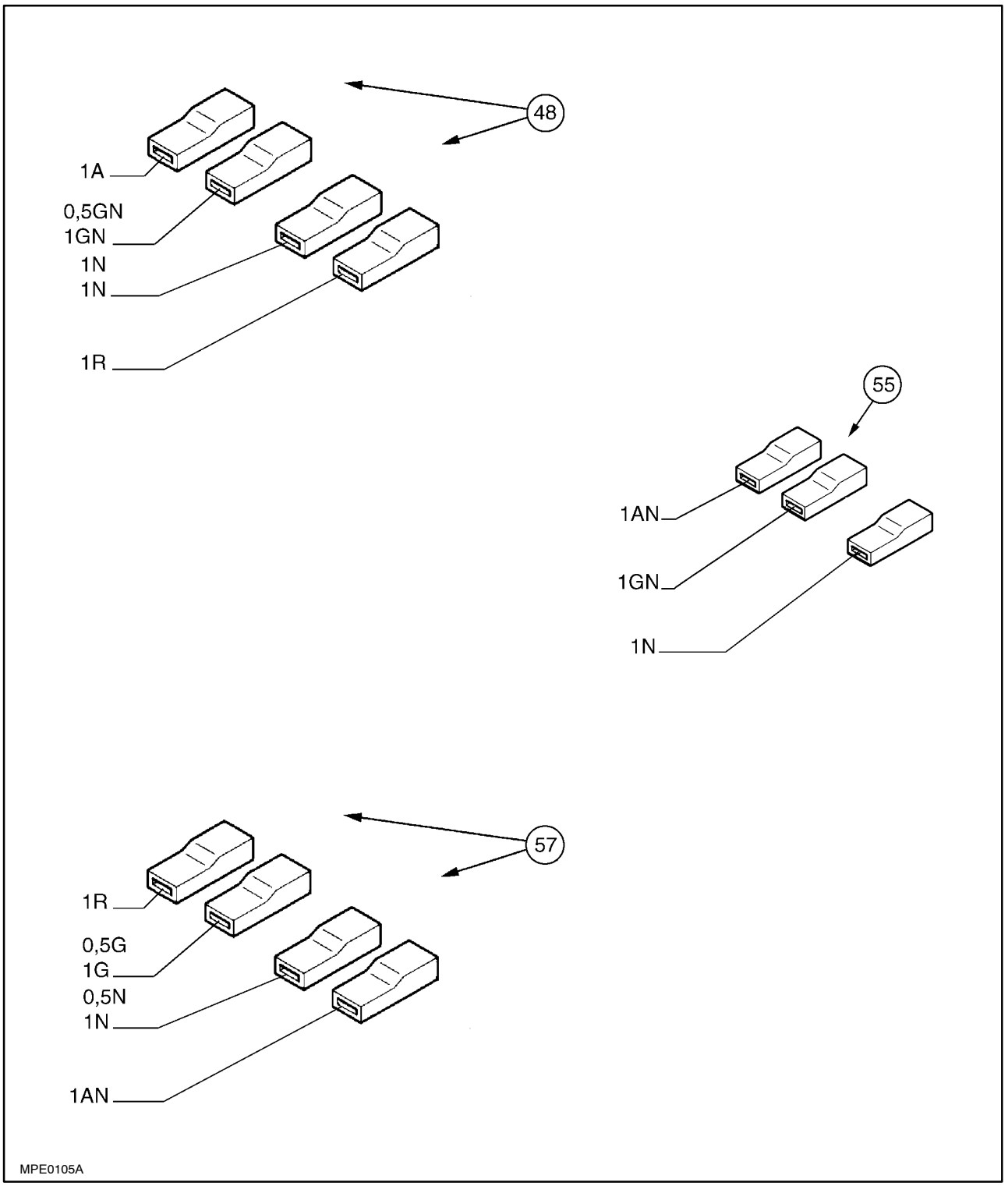
58

▲ Version with Dual Command (2 Speed Power Shift)

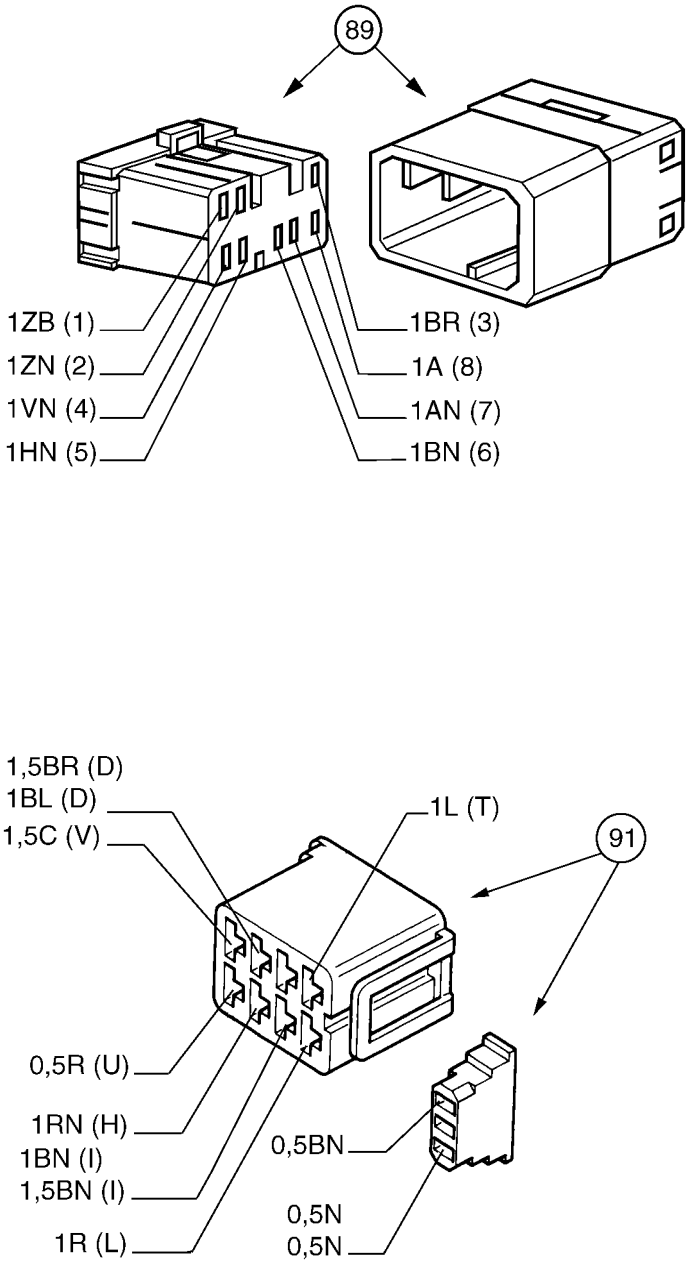


59

*** Power Shuttle version


48
1A
0,5GN
1GN
1N
1N
1R
55
1AN
1GN
1N
57
1R
0,5G
1G
0,5N
1N
1AN
MPE0105A

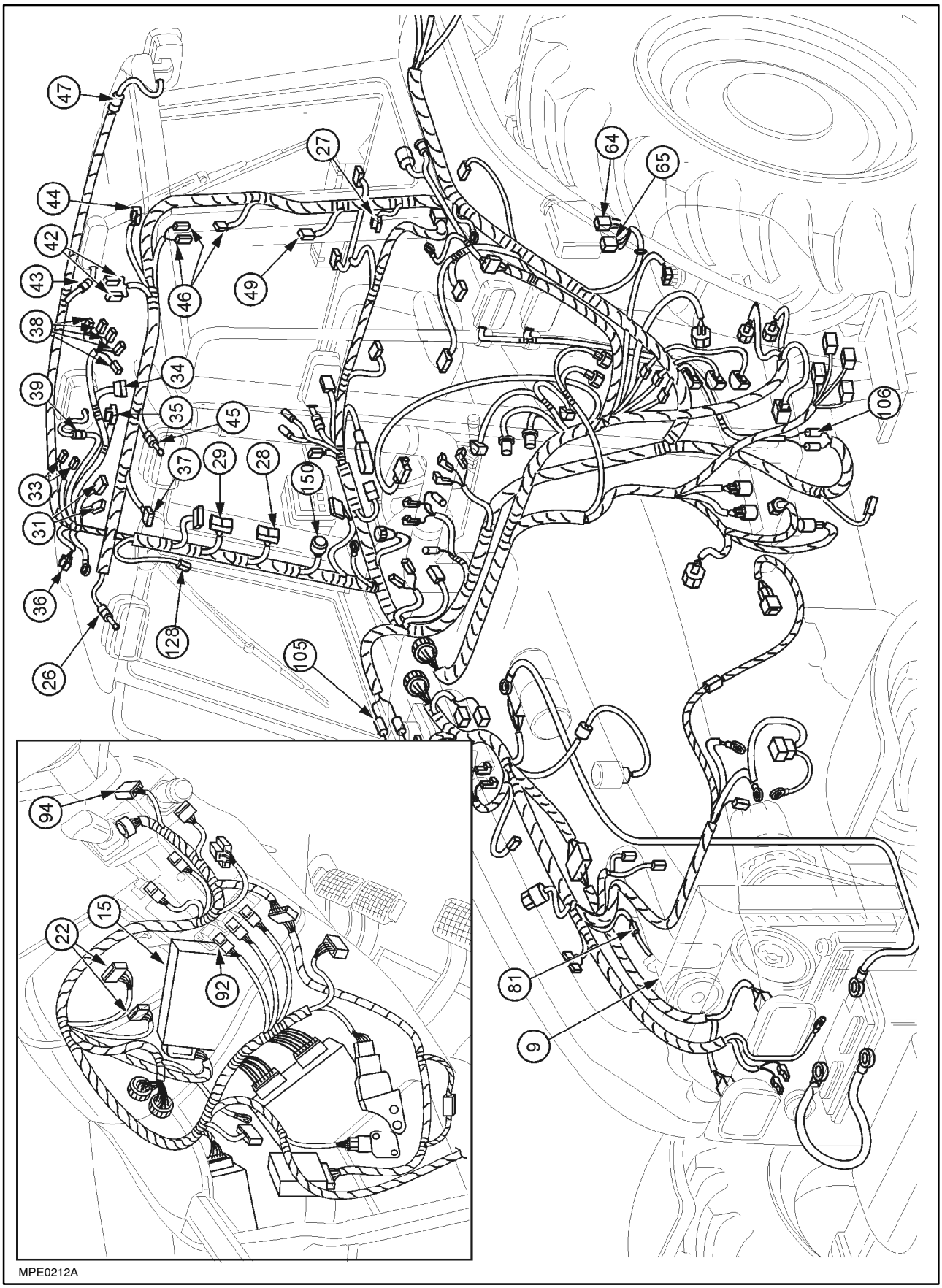
60


89
1ZB (1)
1ZN (2)
1VN (4)
1HN (5)
1BR (3)
1A (8)
1AN (7)
1BN (6)
1,5BR (D)
1BL (D)
1,5C (V)
1L (T)
91
0,5R (U)
1RN (H)
1BN (I)
1,5BN (I)
1R (L)
0,5BN
0,5N
0,5N

MPE0106A

61

WIRING DIAGRAMS H - I - L



MPE0212A

62

WORK LIGHTS, ROTATING BEACON CIRCUIT (Diagram H)

15 Fuses and relay control unit
- F5 Lower front work lights
- F6 Cab rear work lights
- F11 Horn, 8A power socket, cigar lighter, rotating beacon, overhead lighting, radio
- F19 Upper front work lights
- VIII Upper front work lights circuit
- XI Lower front work lights circuit
- XII Rear work lights circuit

22 Instrument panel
- r Work lights

26 RH front auxiliary work light

29 Rotating beacon switch

36 RH rotating beacon power socket

39 Connection for auxiliary work light and RH rear extra direction indicator

44 LH rotating beacon

45 LH front auxiliary work light

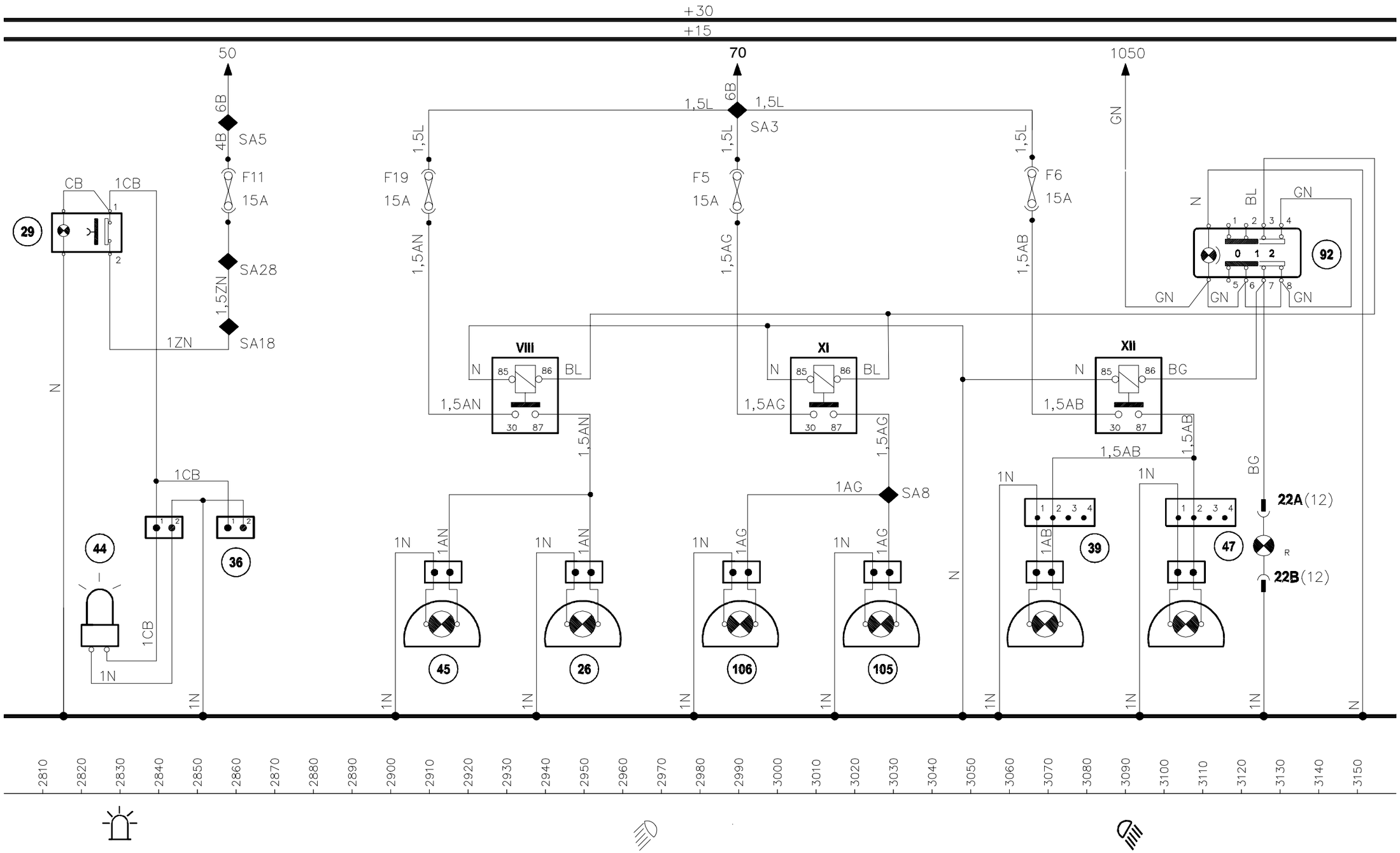
47 Connection for auxiliary work light and LH rear extra direction indicator

92 Work lights switch

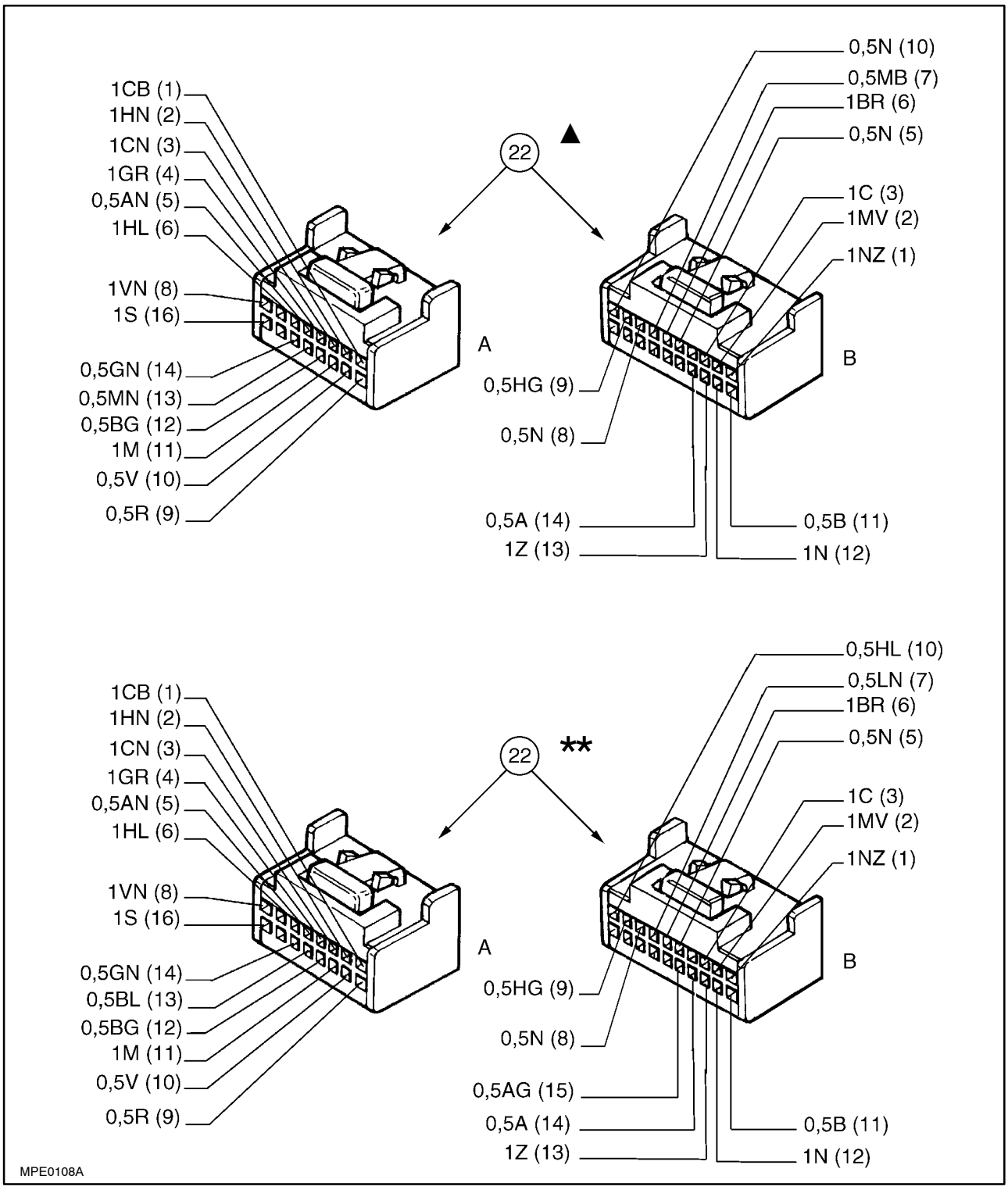
105 RH lower front work light

106 LH lower front work light

WORK LIGHTS AND ROTATING BEACON CIRCUIT - DIAGRAM H



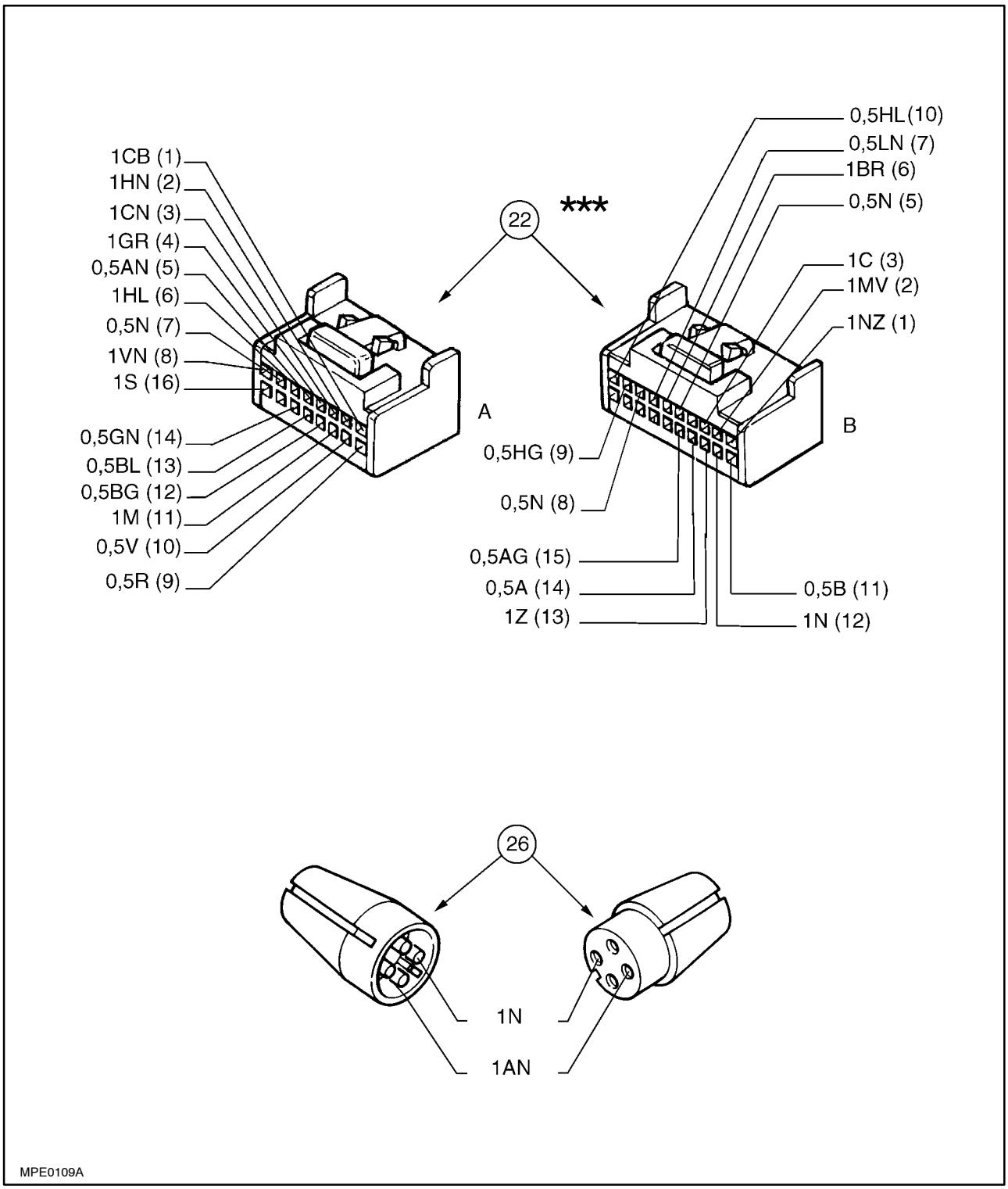
MPD3120A



63

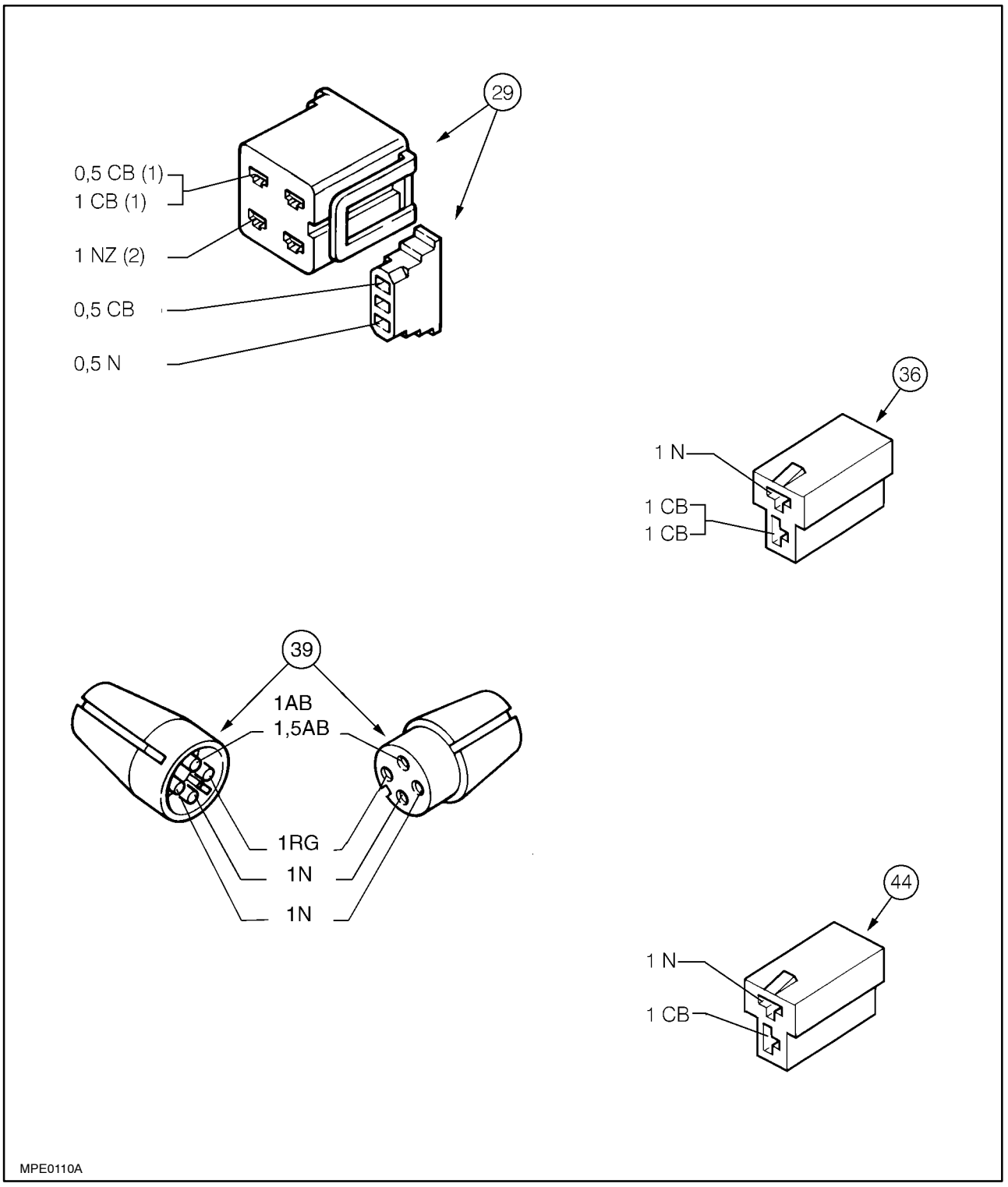
▲ Version with Dual Command (2 Speed Power Shift)

** Version without cab

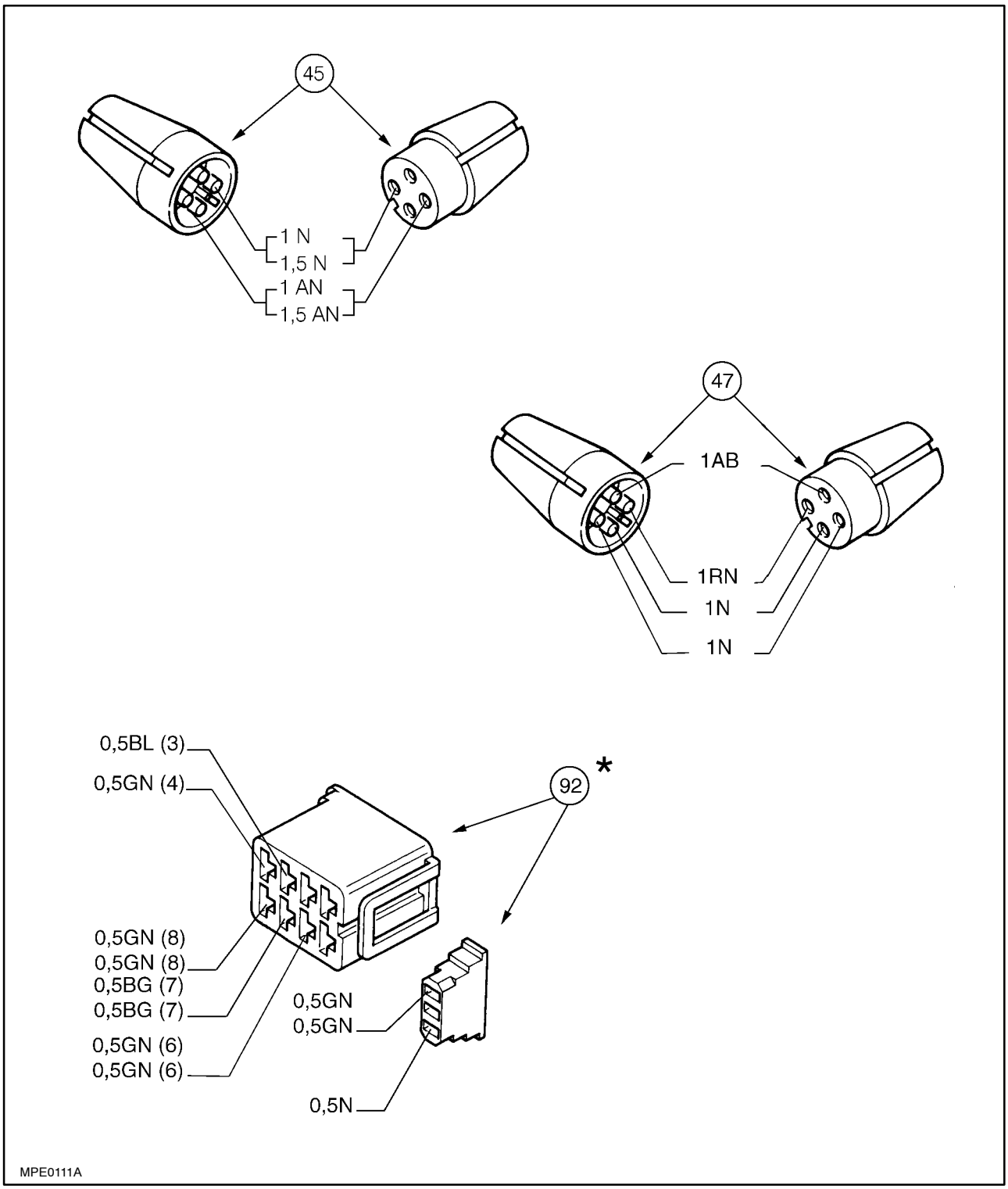


64

*** Power Shuttle version

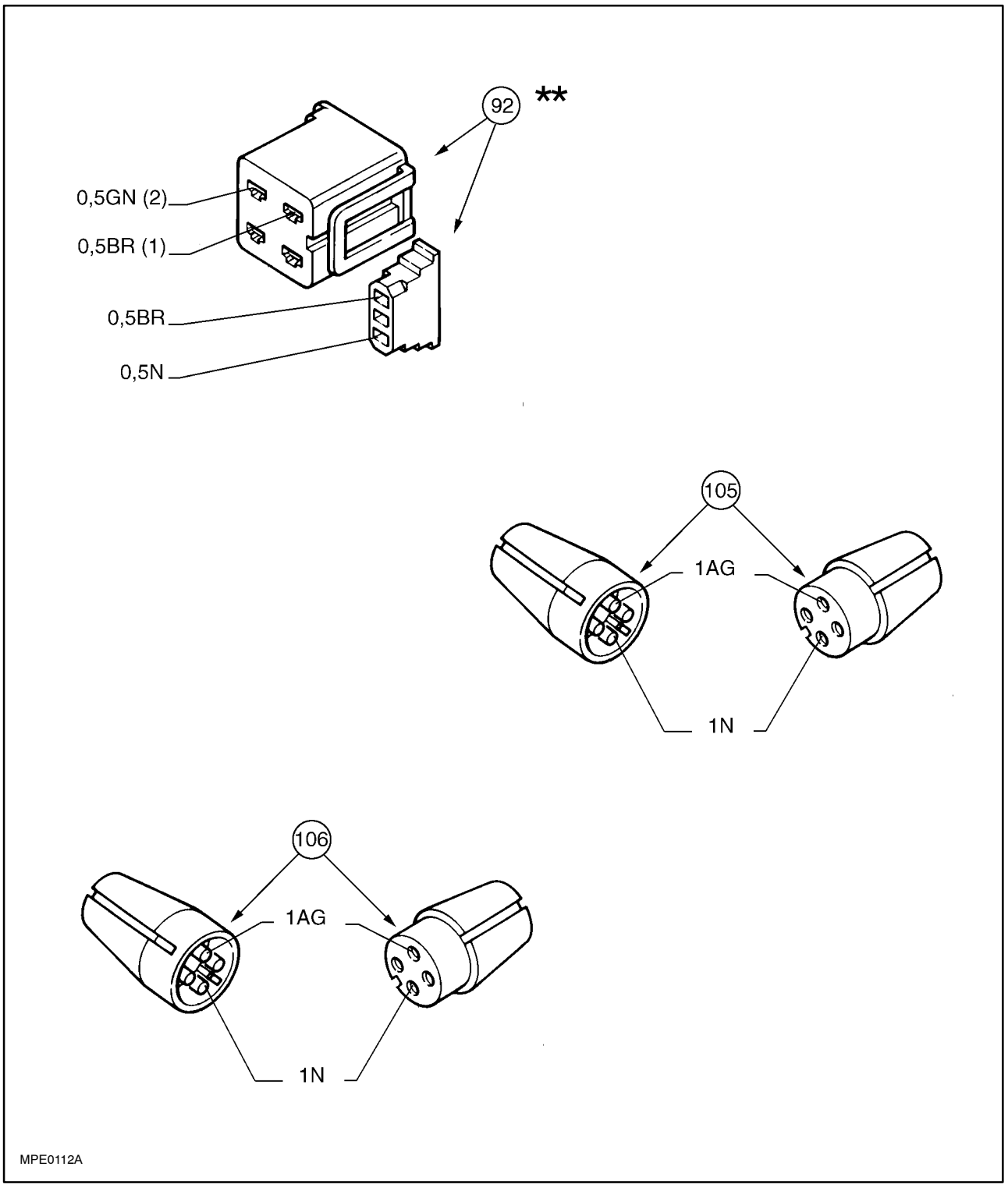

29
0,5 CB (1)
1 CB (1)
1 NZ (2)
0,5 CB
0,5 N
36
1 N
1 CB
1 CB
39
1AB
1,5AB
1RG
1N
1N
44
1 N
1 CB
MPE0110A

65



66

* Version with cab



67

** Version without cab

CAB VENTILATION AND AIR-CONDITIONING SYSTEM, RADIO AND INTERNAL LIGHTING (Diagram I)

9 Air conditioning system compressor

15 Fuses and relay control unit

- F11 Horn, 8A power socket, cigar lighter, rotating beacon, overhead lighting, radio
- F16 Sediment unit, compressor air-conditioner circuit
- F22 Fan unit, radio
- B Air-conditioner circuit

31 Radio connections

33 RH speaker

34 Air-conditioner push-button

35 Ventilation and air-conditioning system connection

38 Ventilation and air-conditioning system electric fan switch

42 LH speaker

46 Cab overhead lighting

49 Left-hand side door switch

81 Connection for air conditioner

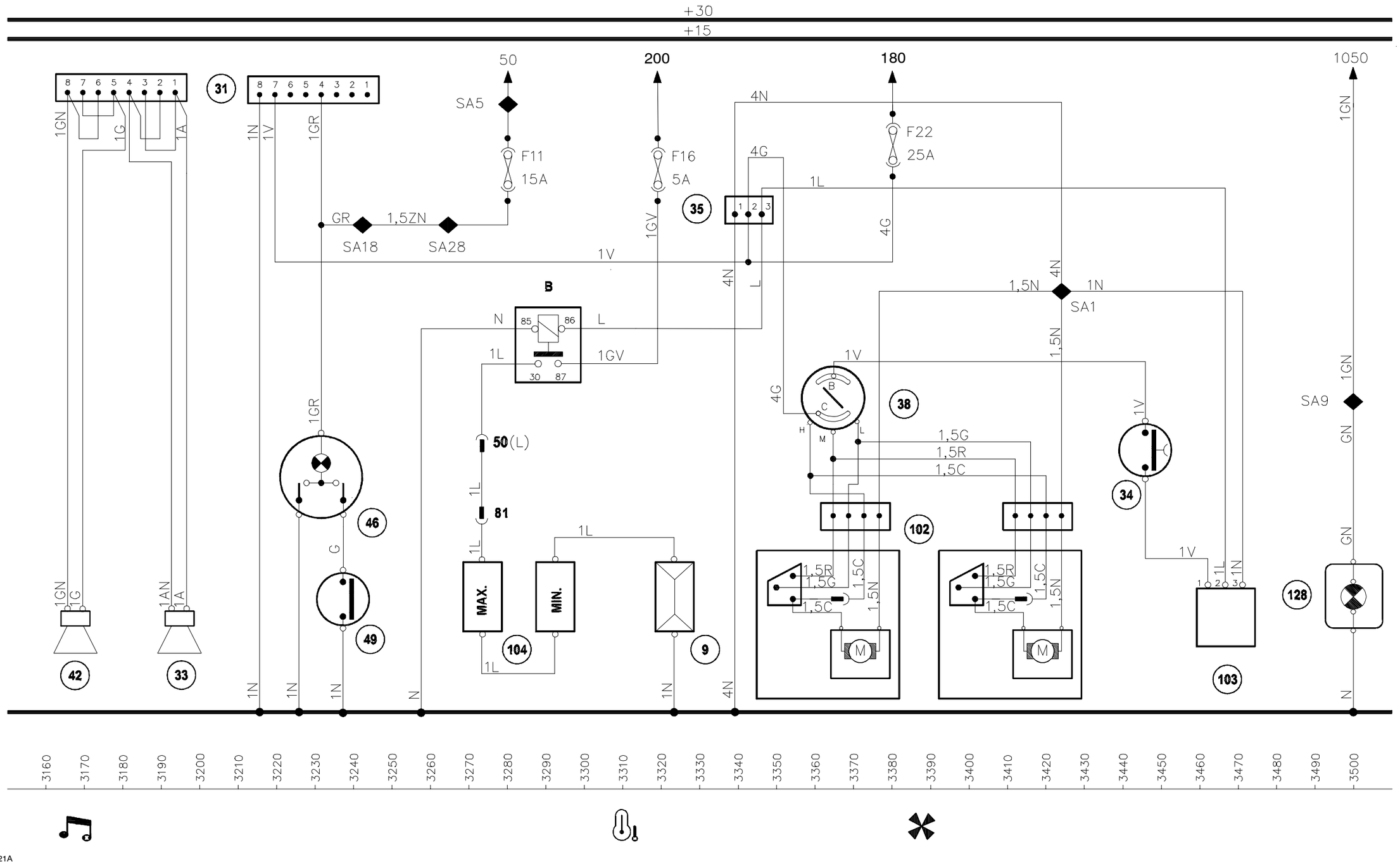
102 Ventilation and air-conditioning system electric fans

103 Air-conditioner electronic thermostat

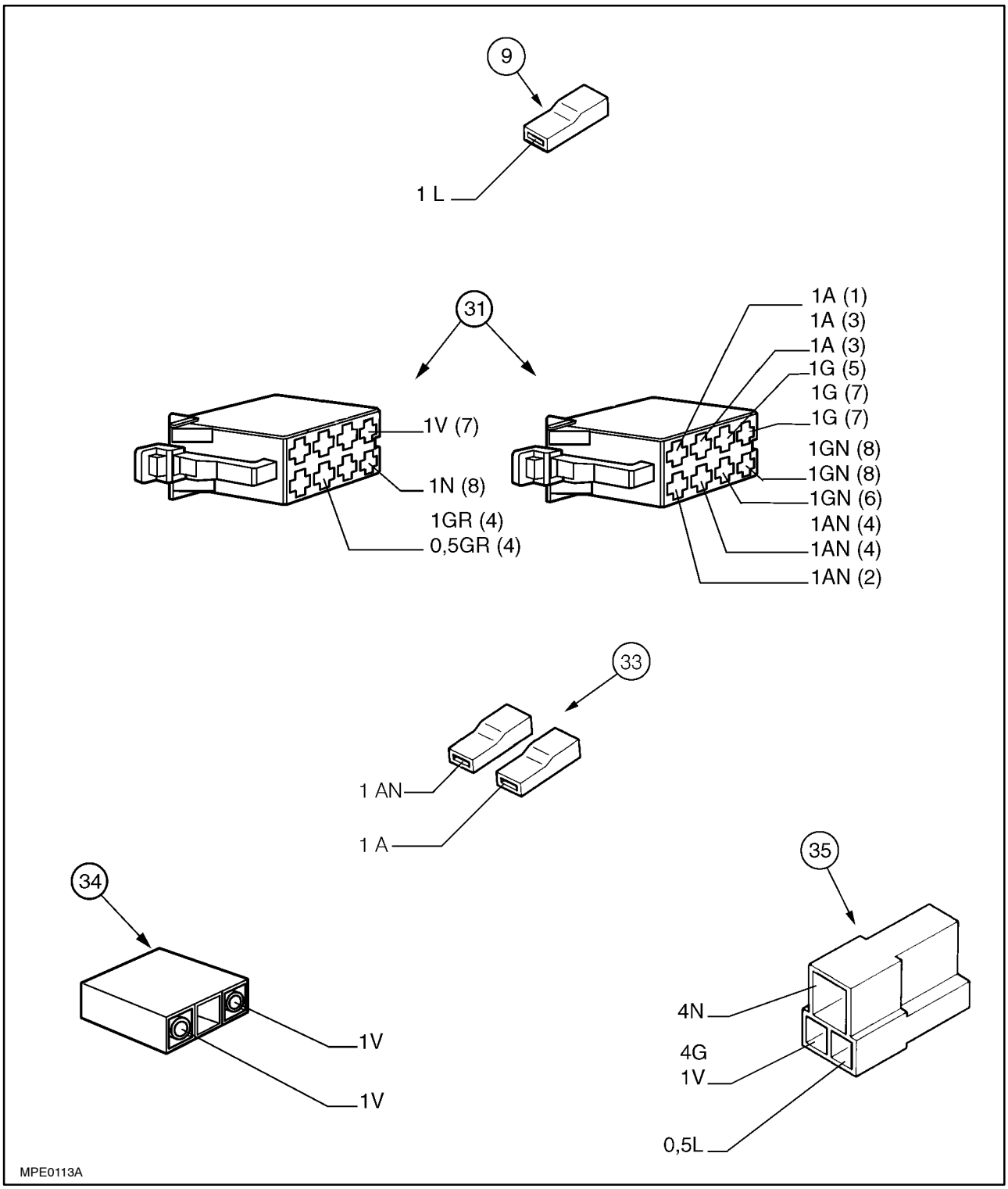
104 Pressure switch for air conditioner

128 Cab right-hand upright light

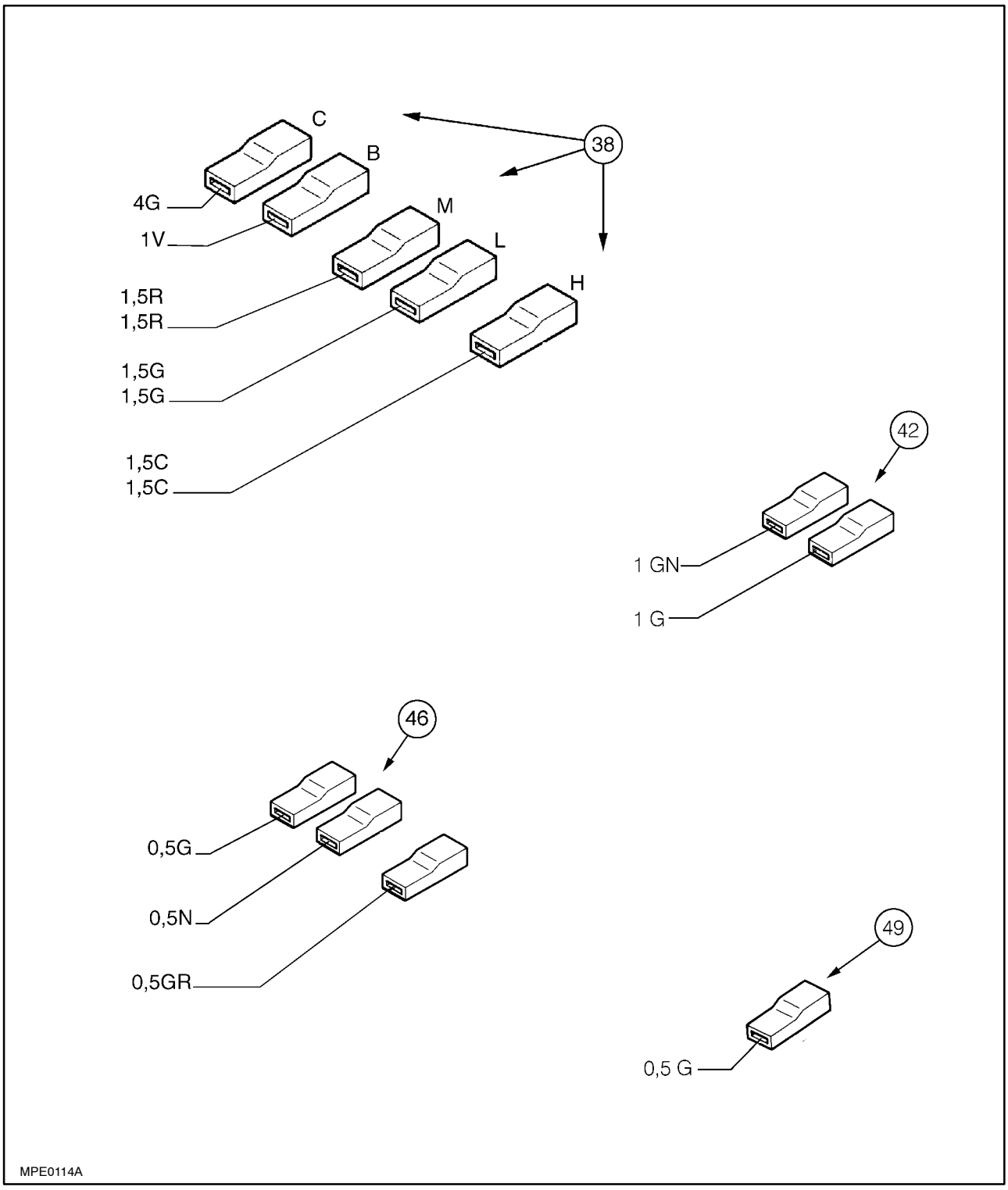
CAB VENTILATION AND AIR-CONDITIONING SYSTEM, RADIO AND INTERNAL LIGHTING CIRCUIT - DIAGRAM I



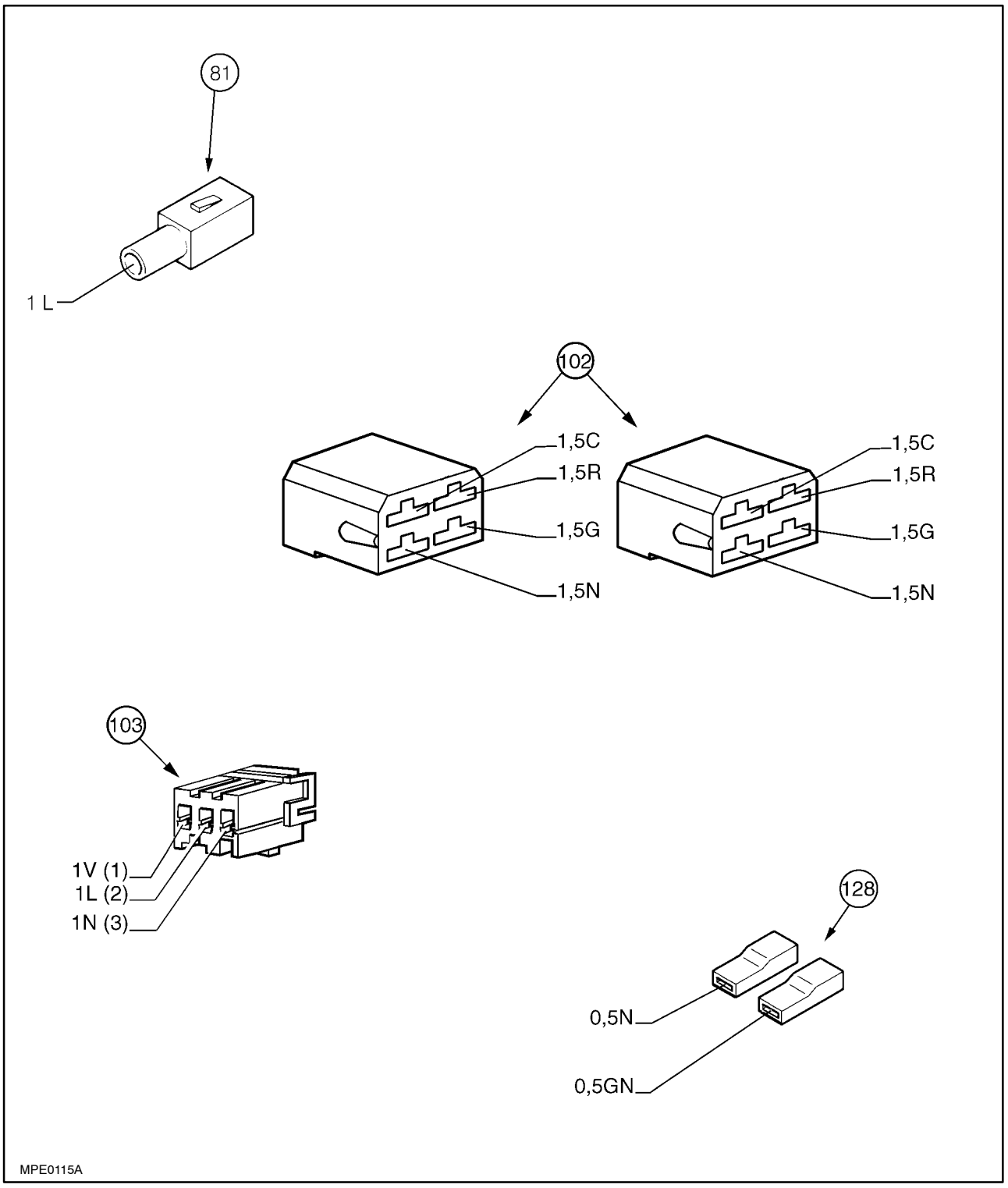
MPD3121A


9
1 L
31
1V (7)
1N (8)
1GR (4)
0,5GR (4)
1A (1)
1A (3)
1A (3)
1G (5)
1G (7)
1G (7)
1GN (8)
1GN (8)
1GN (6)
1AN (4)
1AN (4)
1AN (2)
33
1 AN
1 A
34
1V
1V
35
4N
4G
1V
0,5L
MPE0113A

68


C
B
38
4G
1V
M
L
H
1,5R
1,5R
1,5G
1,5G
1,5C
1,5C
42
1 GN
1 G
46
0,5G
0,5N
0,5GR
49
0,5 G
MPE0114A

69


81
1 L
102
1,5C
1,5R
1,5G
1,5N
1,5C
1,5R
1,5G
1,5N
103
1V (1)
1L (2)
1N (3)
128
0,5N
0,5GN
MPE0115A

70

WINDSCREEN WIPER/WASHER, REAR WINDSCREEN WIPER/WASHER, CIGAR LIGHTER CIRCUIT (Diagram L)

15 Fuses and relay control unit
- F11 Horn, 8A power socket, cigar lighter, rotating beacon, overhead lighting, radio
- F15 Front/rear windscreen wiper and washer

27 Cigar lighter

28 Rear windscreen wiper/washer switch

37 Rear windscreen wiper motor

43 Rear windscreen wiper motor

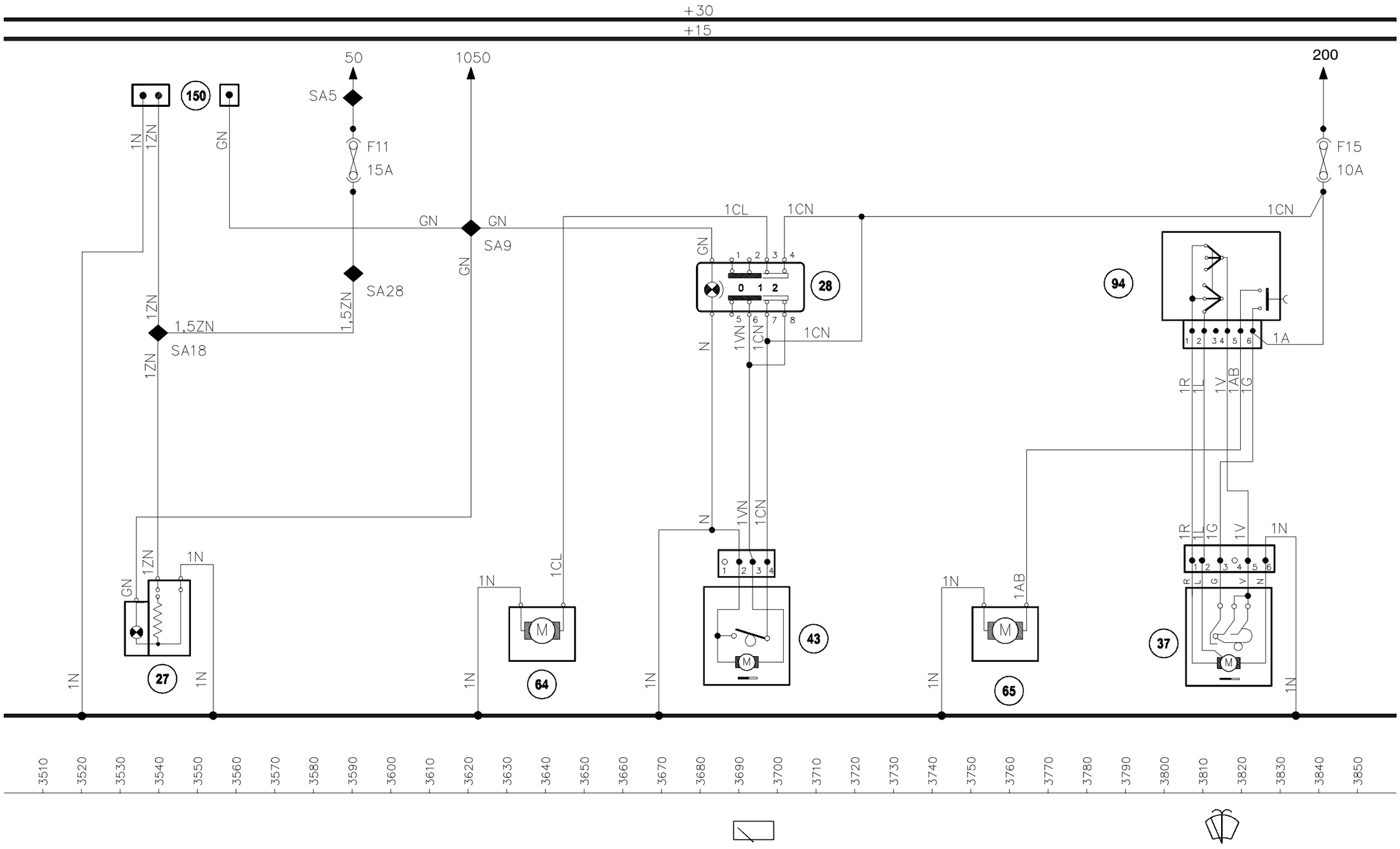
64 Rear windscreen washer motor pump

65 Windscreen washer motor pump

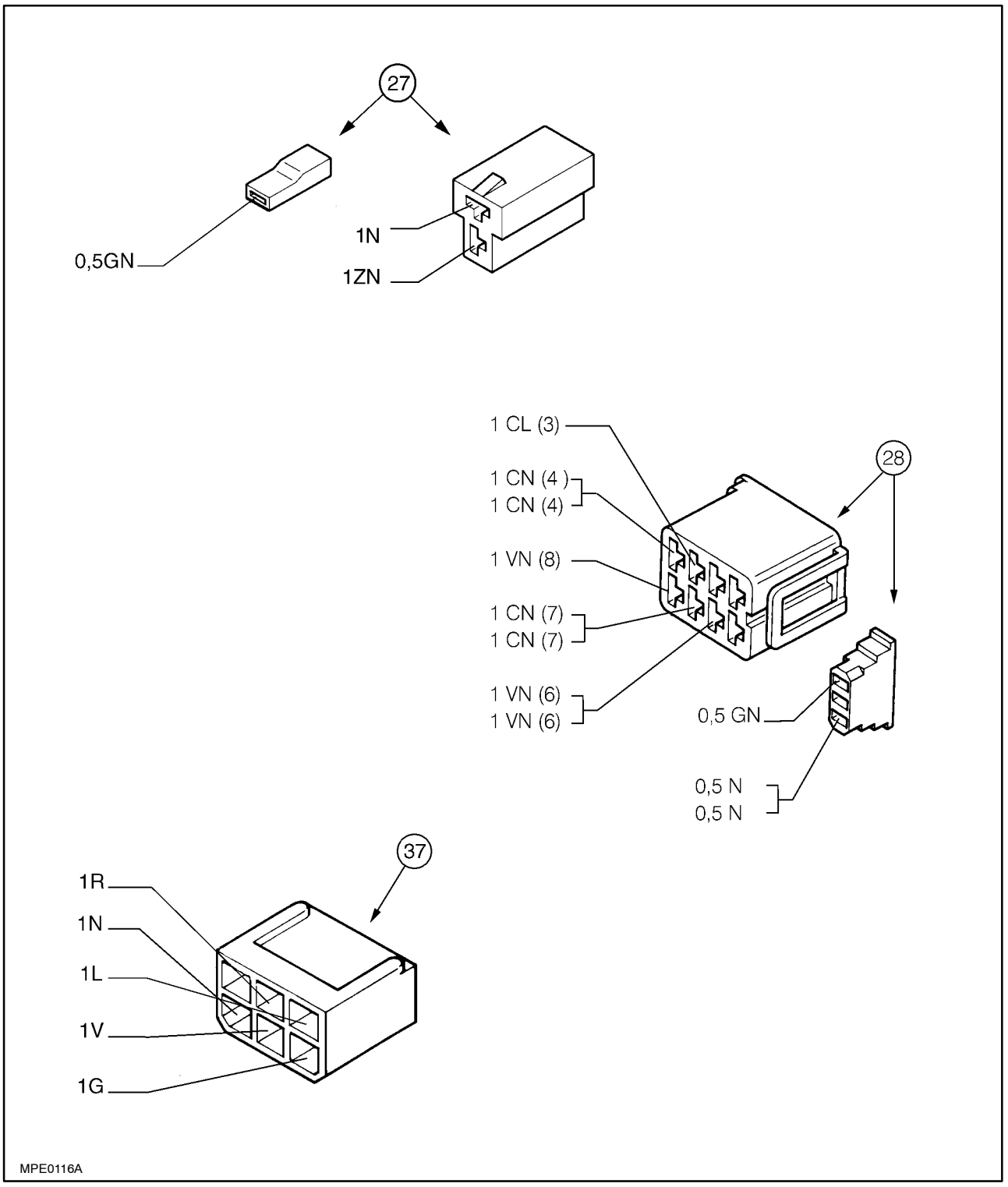
94 Windscreen washer/wiper control

150 Cigar lighter on cab right-hand upright

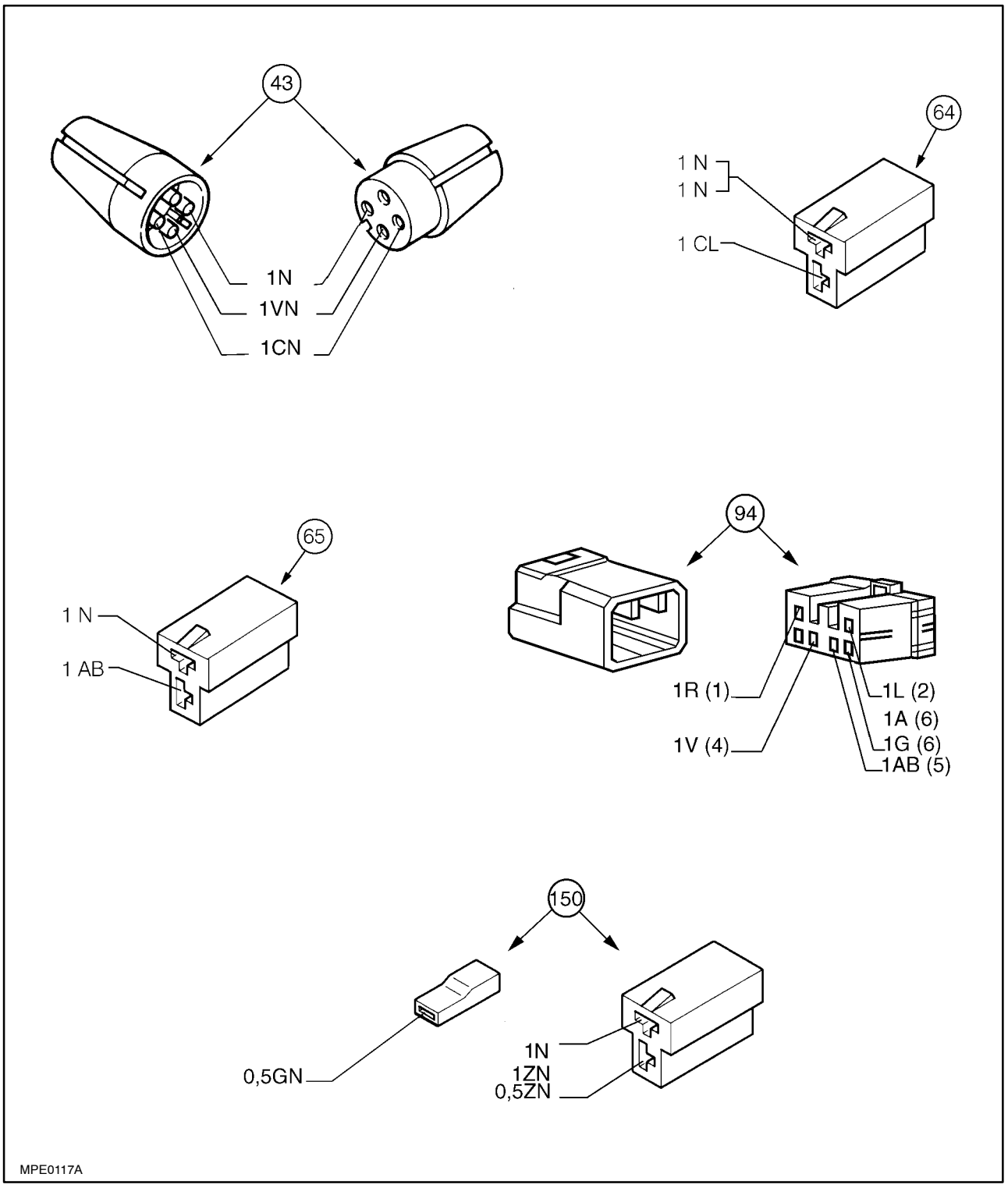
WINDSCREEN WIPER/WASHER, REAR WINDSCREEN WIPER/WASHER AND CIGAR LIGHTER CIRCUIT - DIAGRAM L



MPD3122A

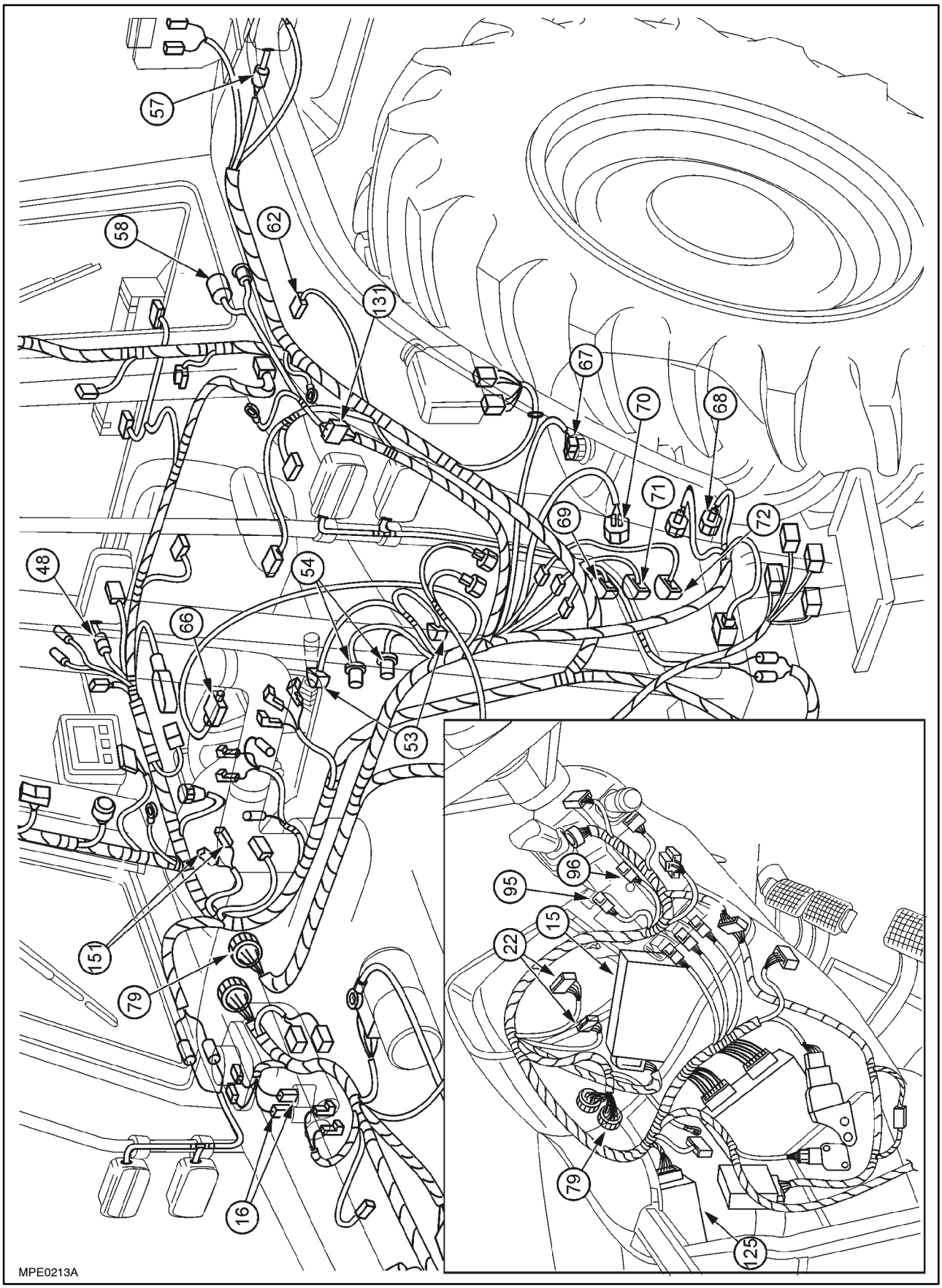

27
0,5GN
1N
1ZN
1 CL (3)
1 CN (4)
1 CN (4)
1 VN (8)
1 CN (7)
1 CN (7)
1 VN (6)
1 VN (6)
28
0,5 GN
0,5 N
0,5 N
37
1R
1N
1L
1V
1G
MPE0116A

71


43
1N
1VN
1CN
64
1 N
1 N
1 CL
65
1 N
1 AB
94
1R (1)
1V (4)
1L (2)
1A (6)
1G (6)
1AB (5)
150
0,5GN
1N
1ZN
0,5ZN
MPE0117A

72

WIRING DIAGRAMS M - N - O



73

DIFFERENTIAL LOCK AND BRAKE LIGHTS CIRCUIT
(Version with Power Shuttle)
(Diagram M)

15 Fuses and relay control unit
- F12 Trailer brake circuit, instruments, seat safety circuit
- F17 4WD, differential lock circuit
- F21 Brake lights, seat
- C Differential lock circuit
- D Brake lights circuit
- VII Differential lock and brake lights circuit
- X Differential lock circuit

16 Brake lights switches

22 Instrument panel
- I Handbrake ON
- z Trailer brake ON

48 RH tail light

57 LH tail light

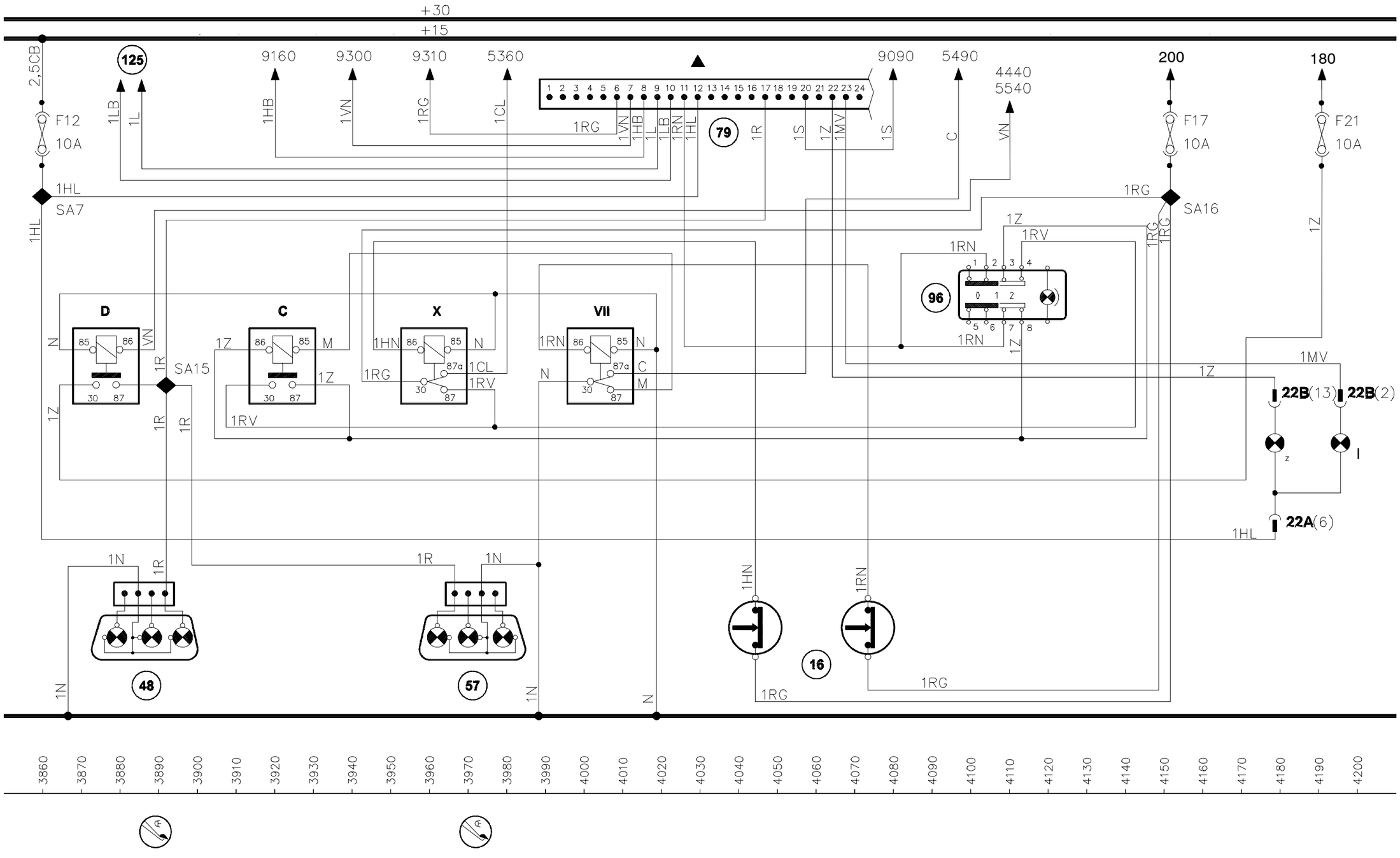
79 Transmission side system connection (48 PIN)

96 Differential lock switch

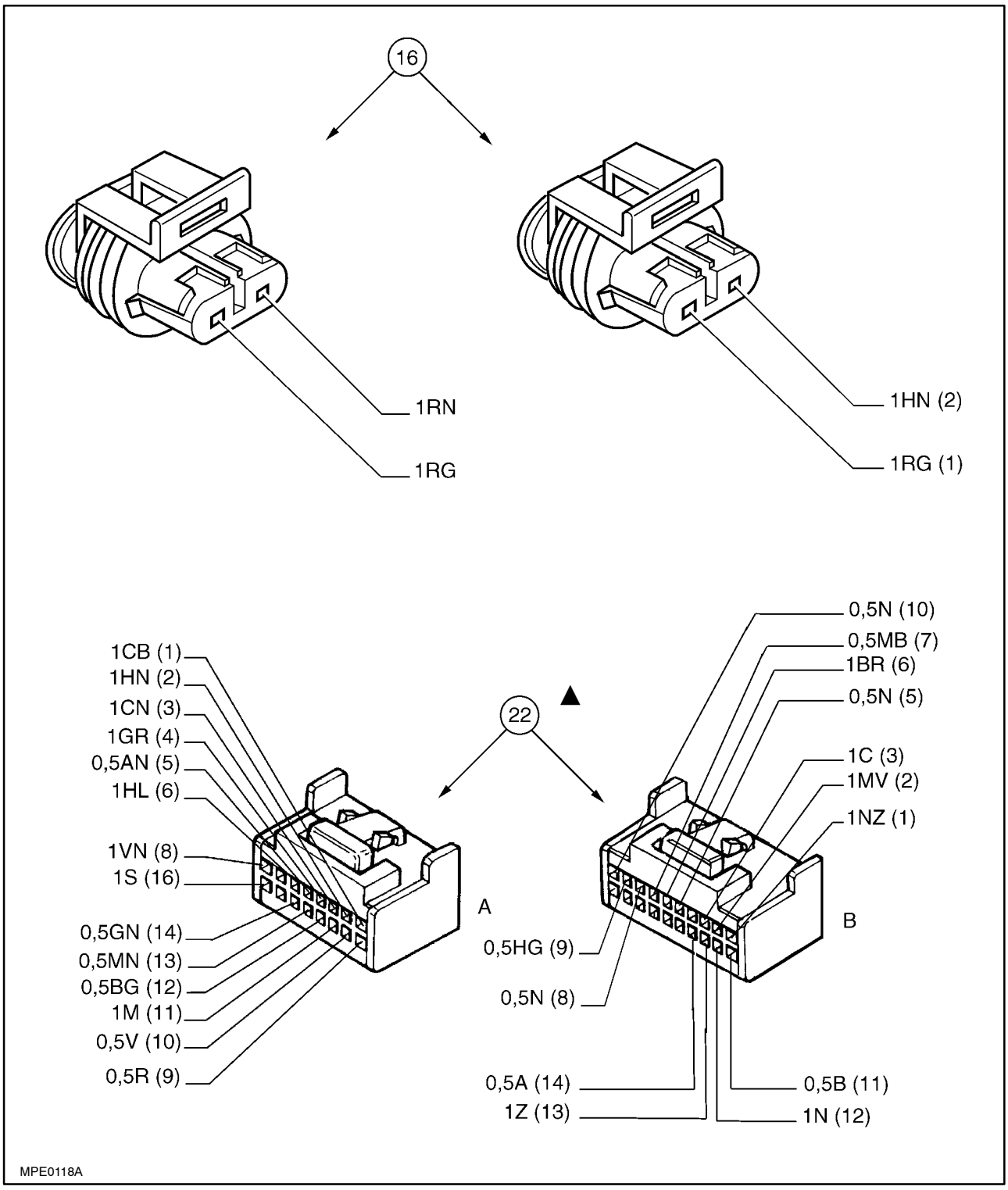
125 Electronic flasher

▲ See diagram O.

DIFFERENTIAL LOCK AND BRAKE LIGHTS CIRCUIT (Version with Power Shuttle) - DIAGRAM M

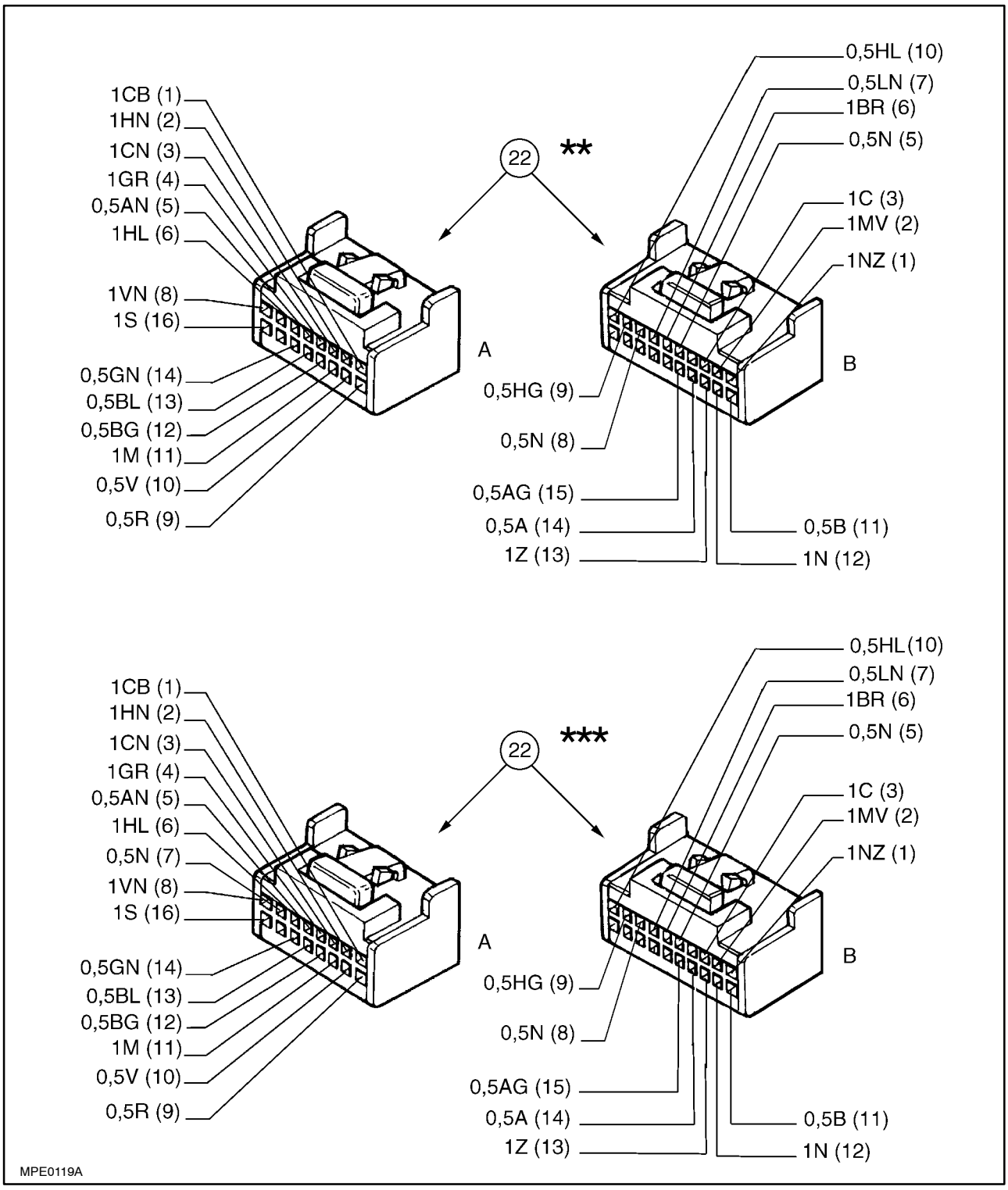


MPD3123A



74

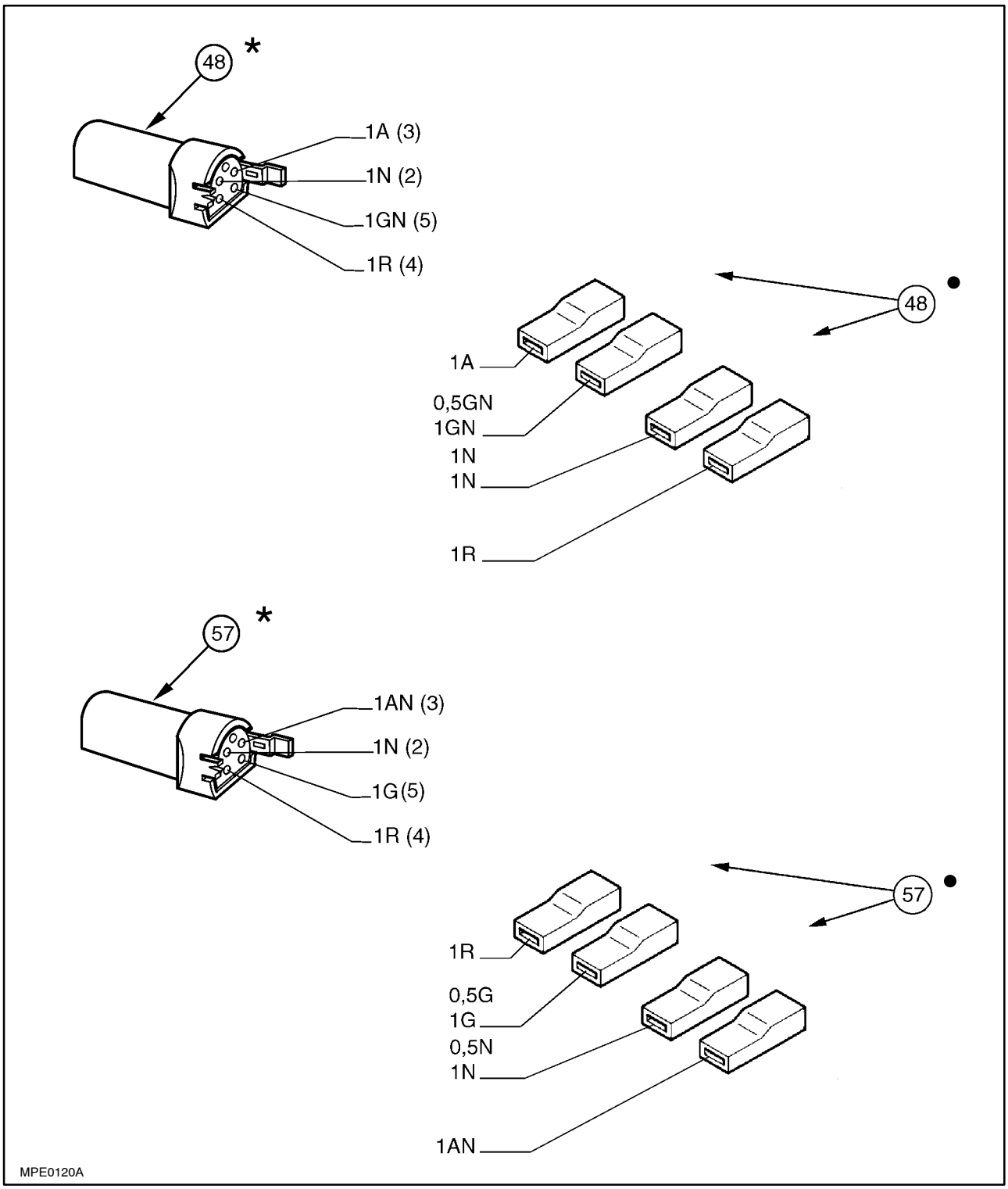
▲ Version with Dual Command (2 Speed Power Shift)



75

** Version without cab

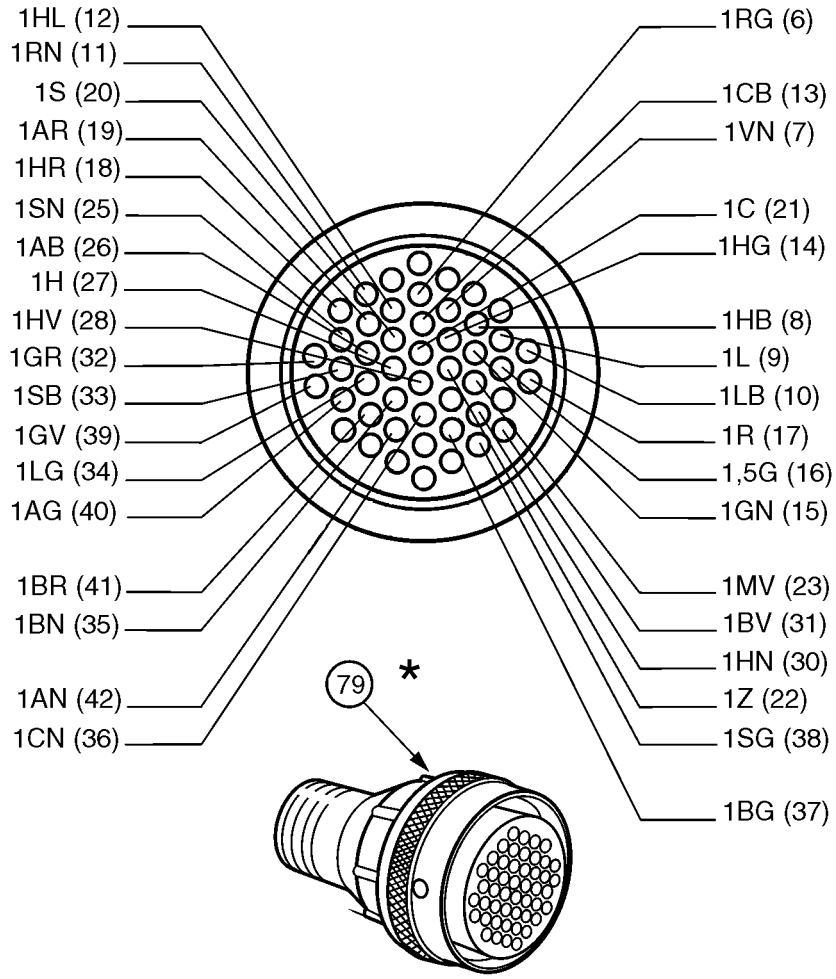
*** Power Shuttle version



76

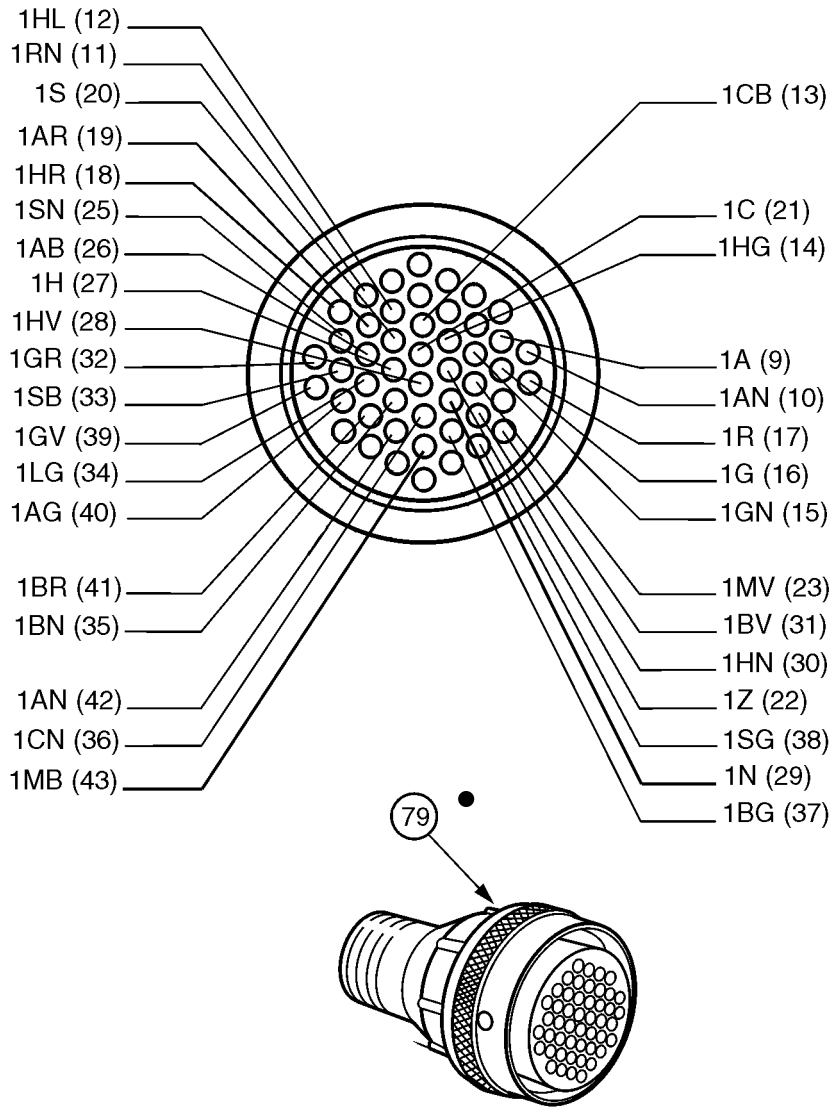
* Version with cab

● Version without cab (ISO)



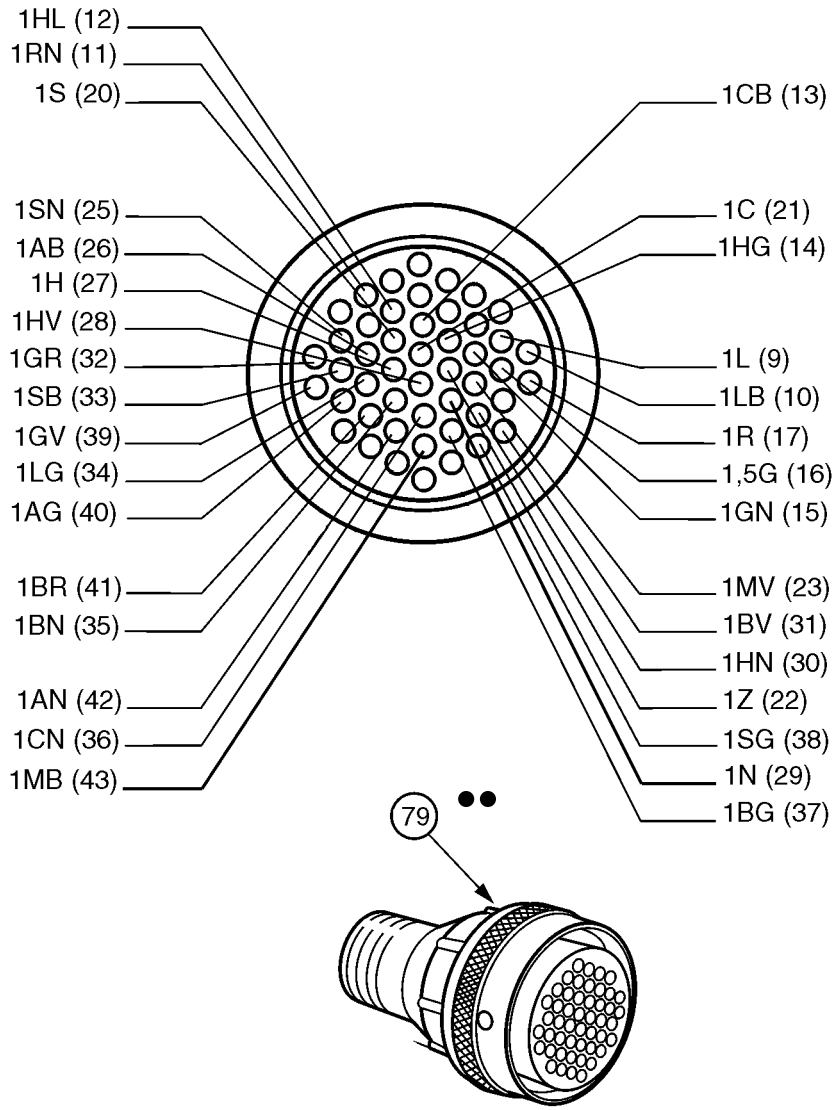
77

* Version with cab



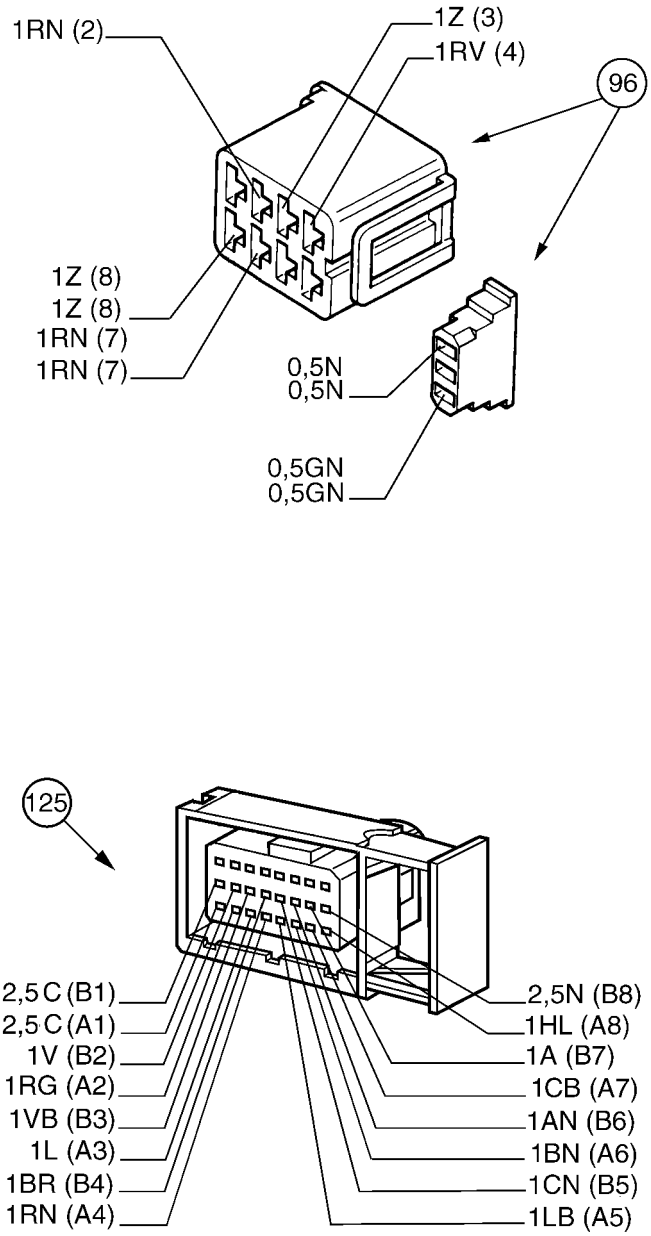
78

- Version without cab (ISO)



79

●● Version without cab (NASO)


1RN (2)
1Z (3)
1RV (4)
96
1Z (8)
1Z (8)
1RN (7)
1RN (7)
0,5N
0,5N
0,5GN
0,5GN
125
2,5 C (B1)
2,5 C (A1)
1V (B2)
1RG (A2)
1VB (B3)
1L (A3)
1BR (B4)
1RN (A4)
2,5N (B8)
1HL (A8)
1A (B7)
1CB (A7)
1AN (B6)
1BN (A6)
1CN (B5)
1LB (A5)

MPE0124A

80

4WD, TRAILER BRAKE, PTO CIRCUIT (Version with Power Shuttle) (Diagram N)

15 Fuses and relay control unit
- F12 Trailer brake circuit, instruments, seat safety circuit
- F17 4WD, differential lock circuit
- F18 Rear power take-off circuit
- E Trailer brake circuit
- F Electrohydraulic PTO circuit
- G Electrohydraulic PTO circuit
- H Trailer brake circuit
- II Electrohydraulic 4WD circuit

22 Instrument panel
- h 4WD ON
- l Handbrake ON
- s PTO ON

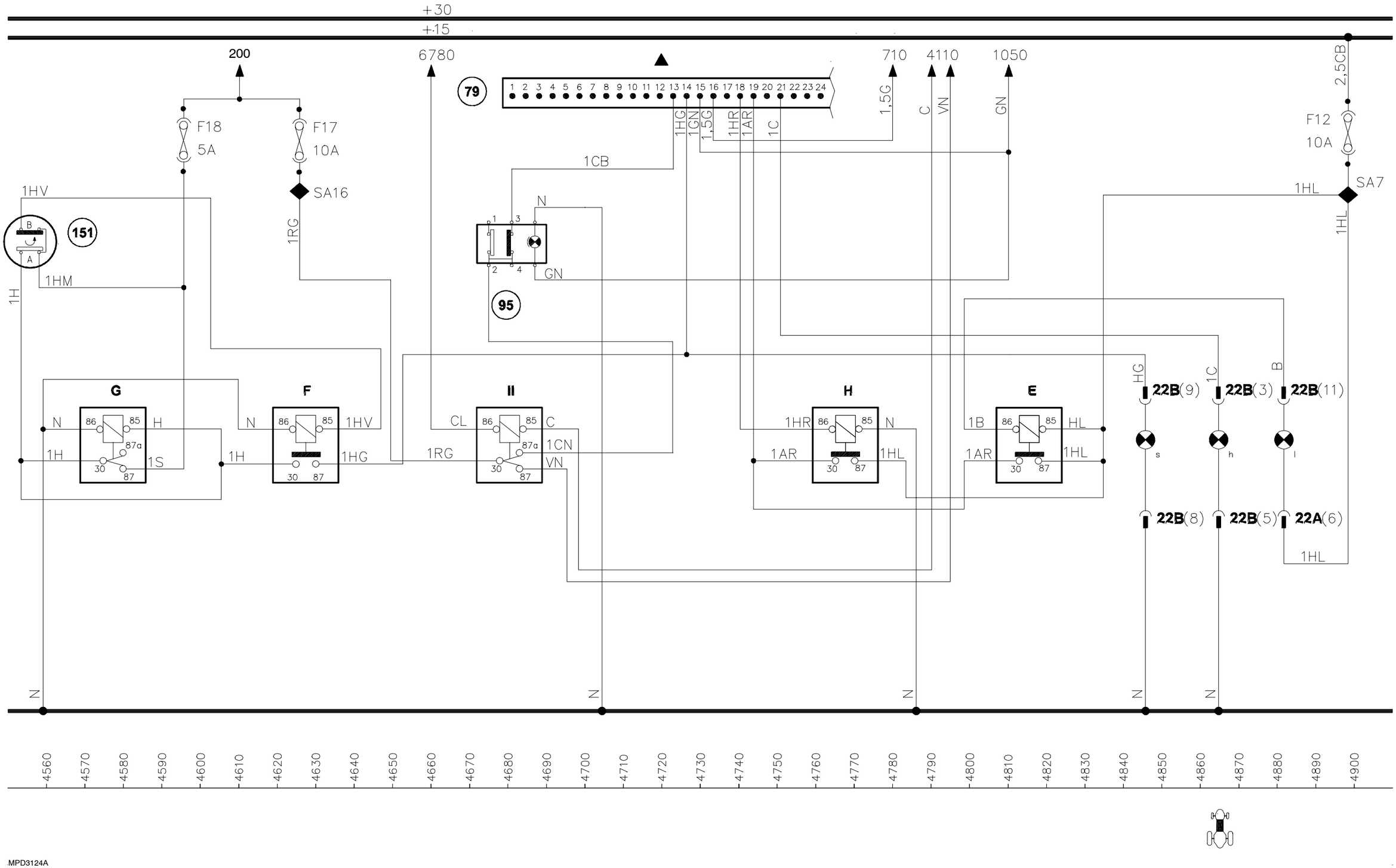
79 Transmission side system connection (48 PIN)

95 4WD control switch

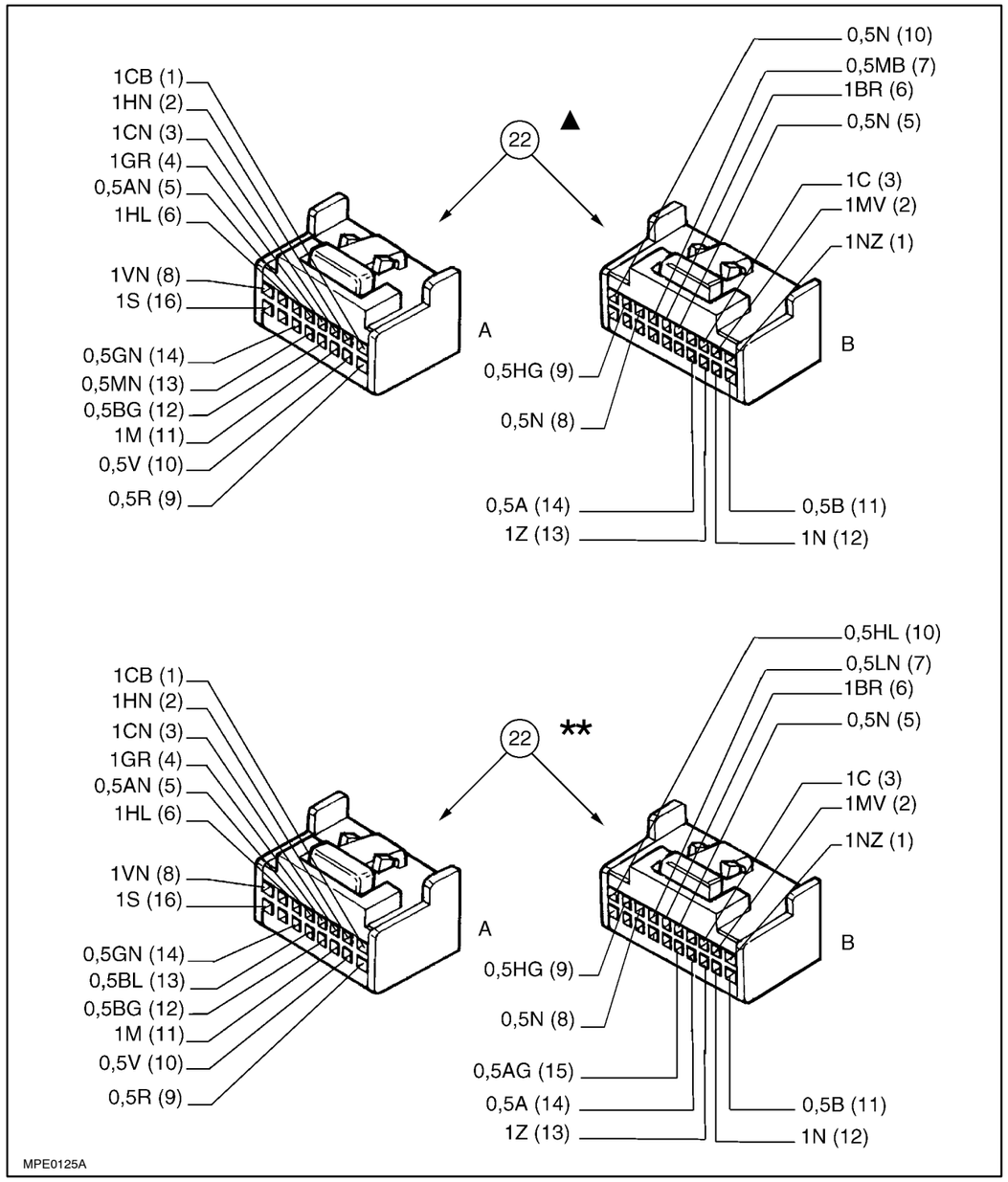
151 Rear PTO switch

▲ See diagram O.

4WD, TRAILER BRAKE, PTO CIRCUIT (Version with Power Shuttle) - DIAGRAM N



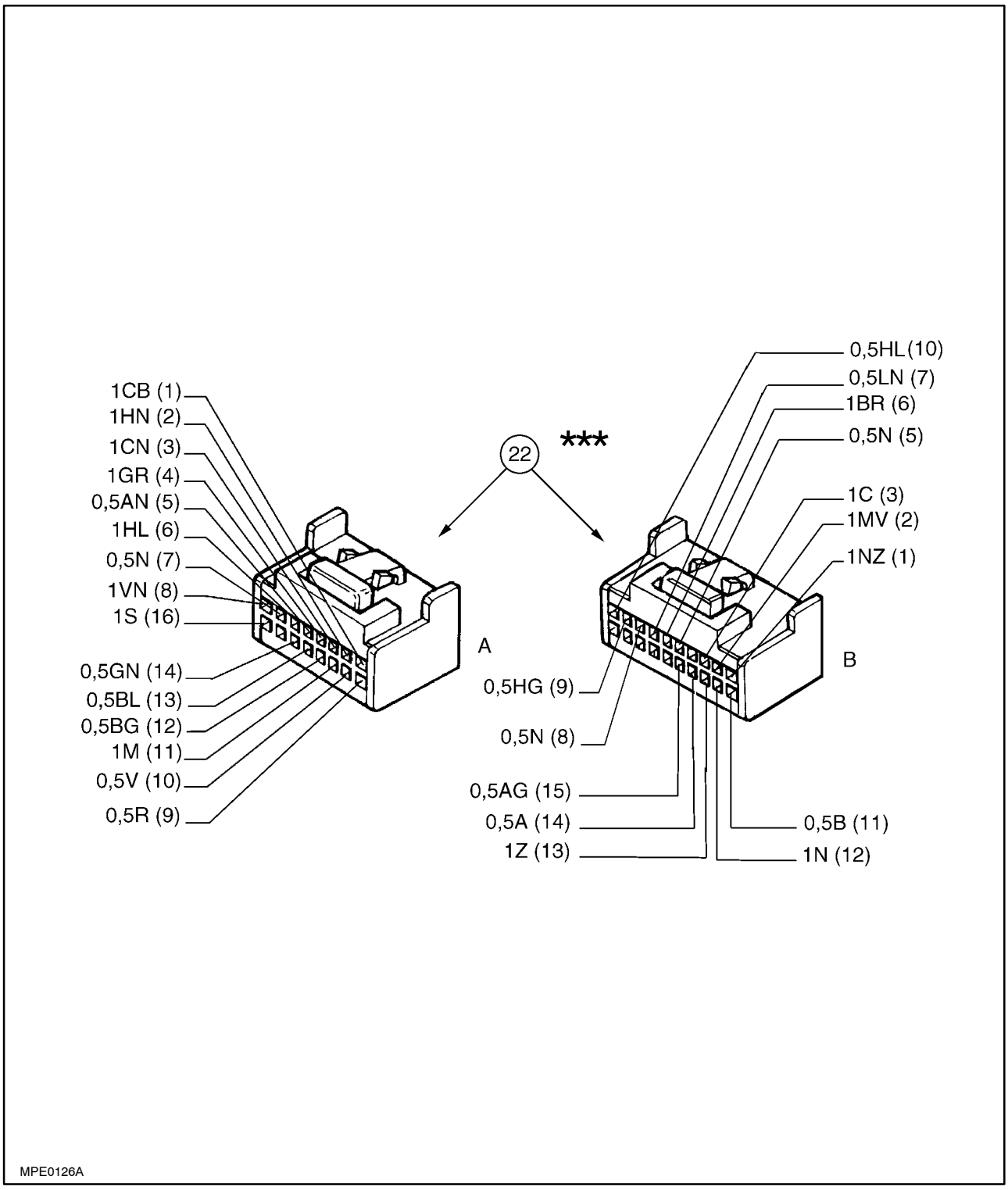
MPD3124A



81

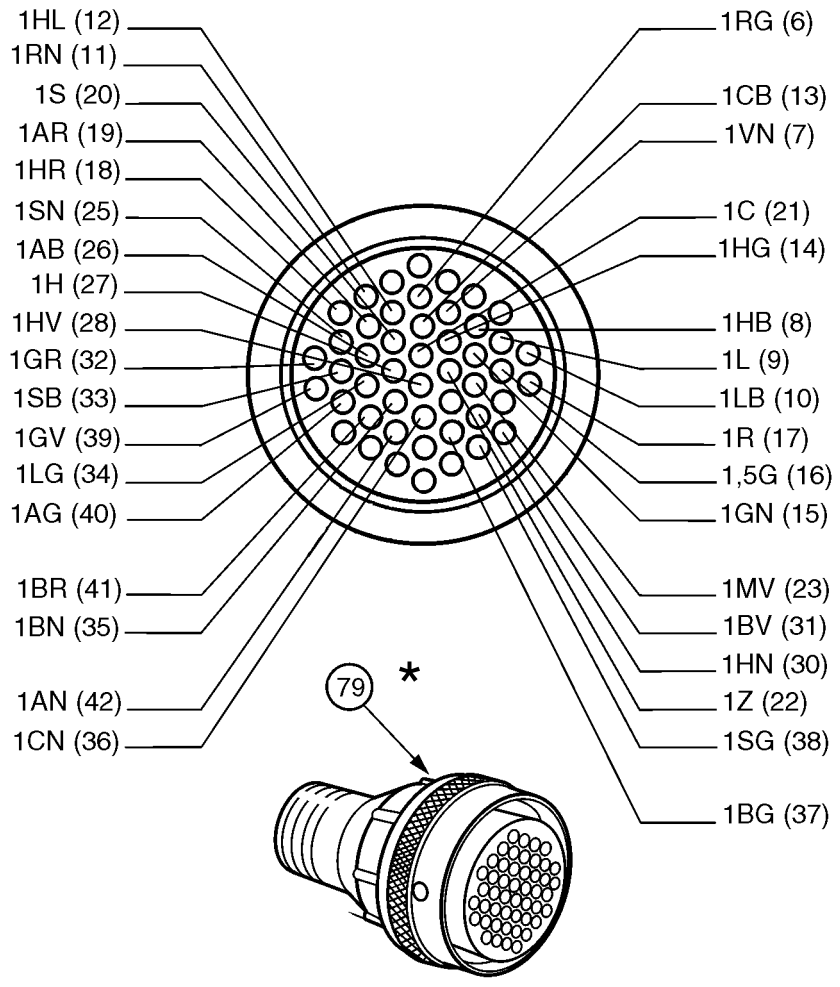
▲ Version with Dual Command (2 Speed Power Shift)

** Version without cab



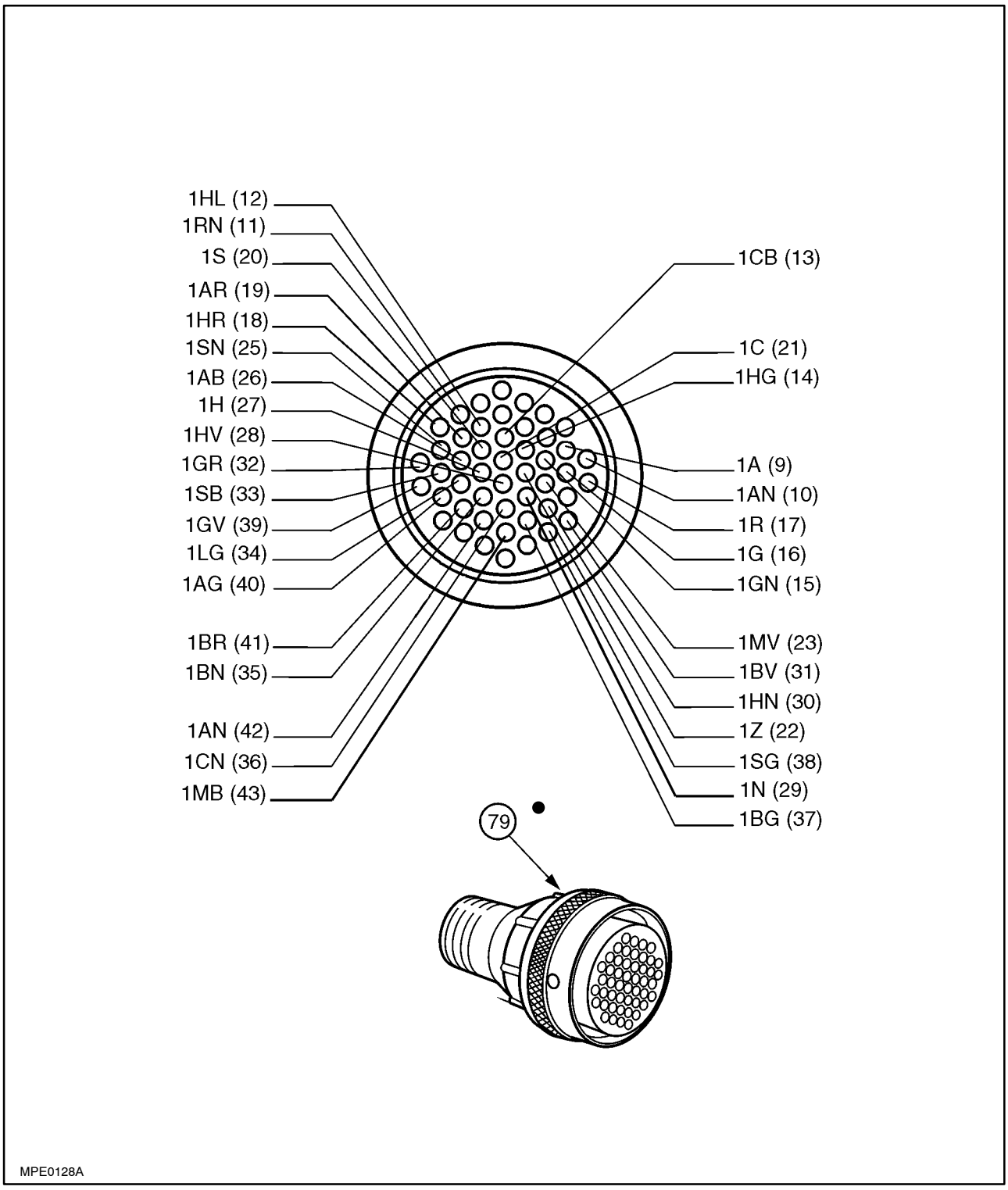
82

*** Power Shuttle version



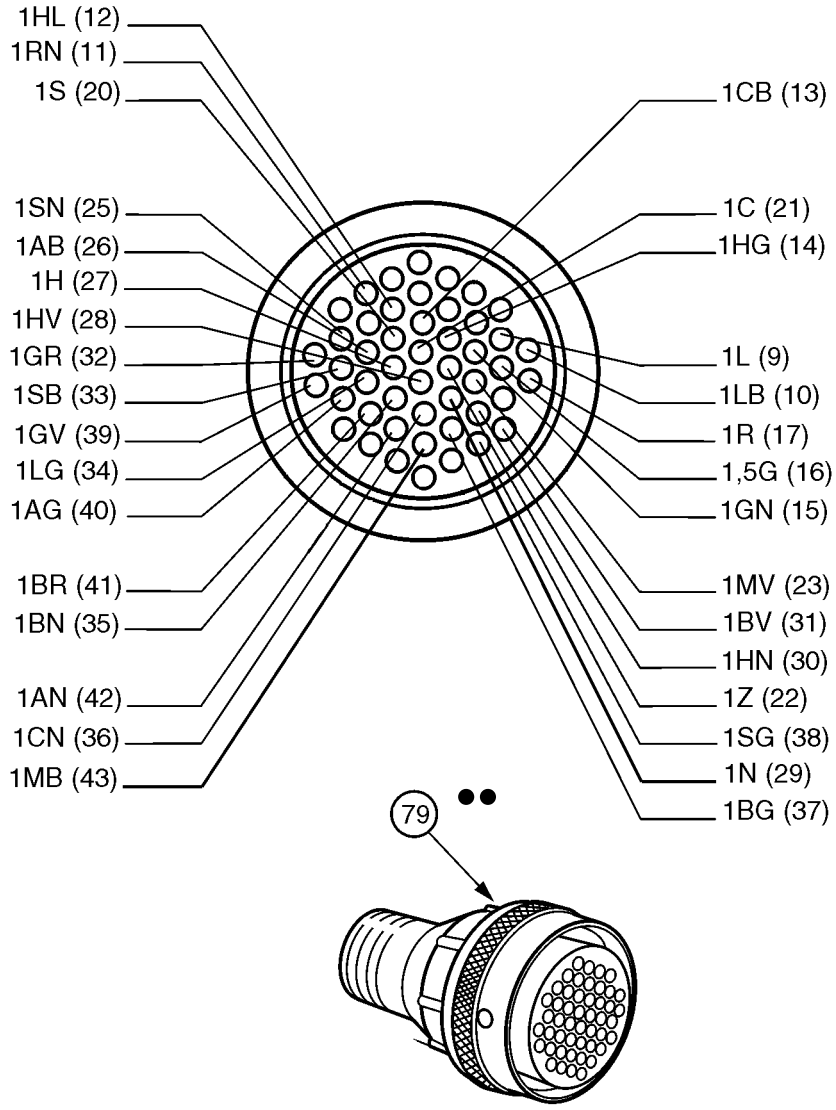
83

* Version with cab



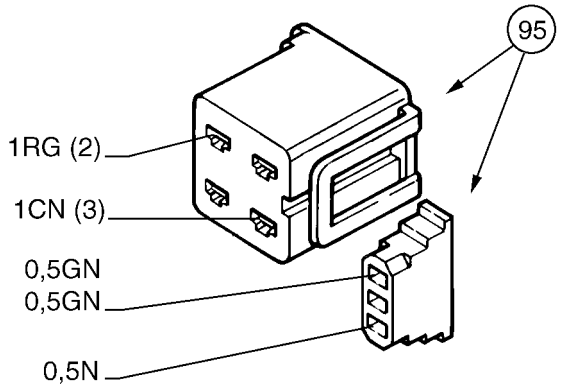
84

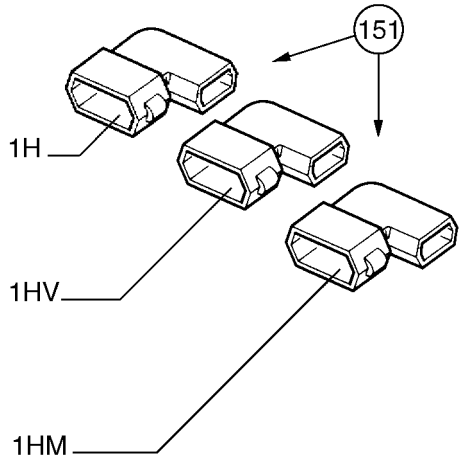
- Version without cab (ISO)



85

●● Version without cab (NASO)





MPE0130A

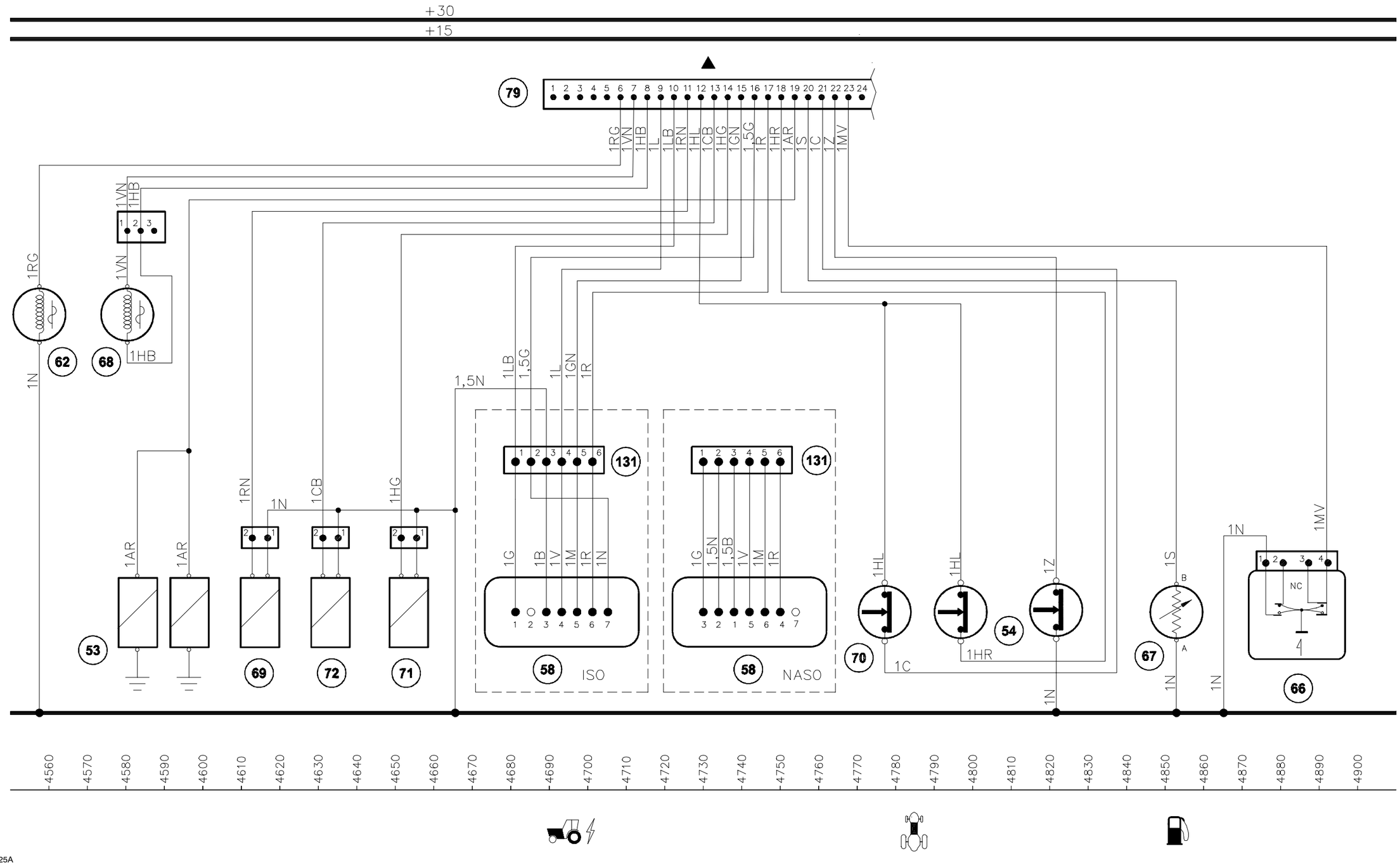
86

TRANSMISSION CIRCUIT
(Version with Power Shuttle)
(Diagram O)

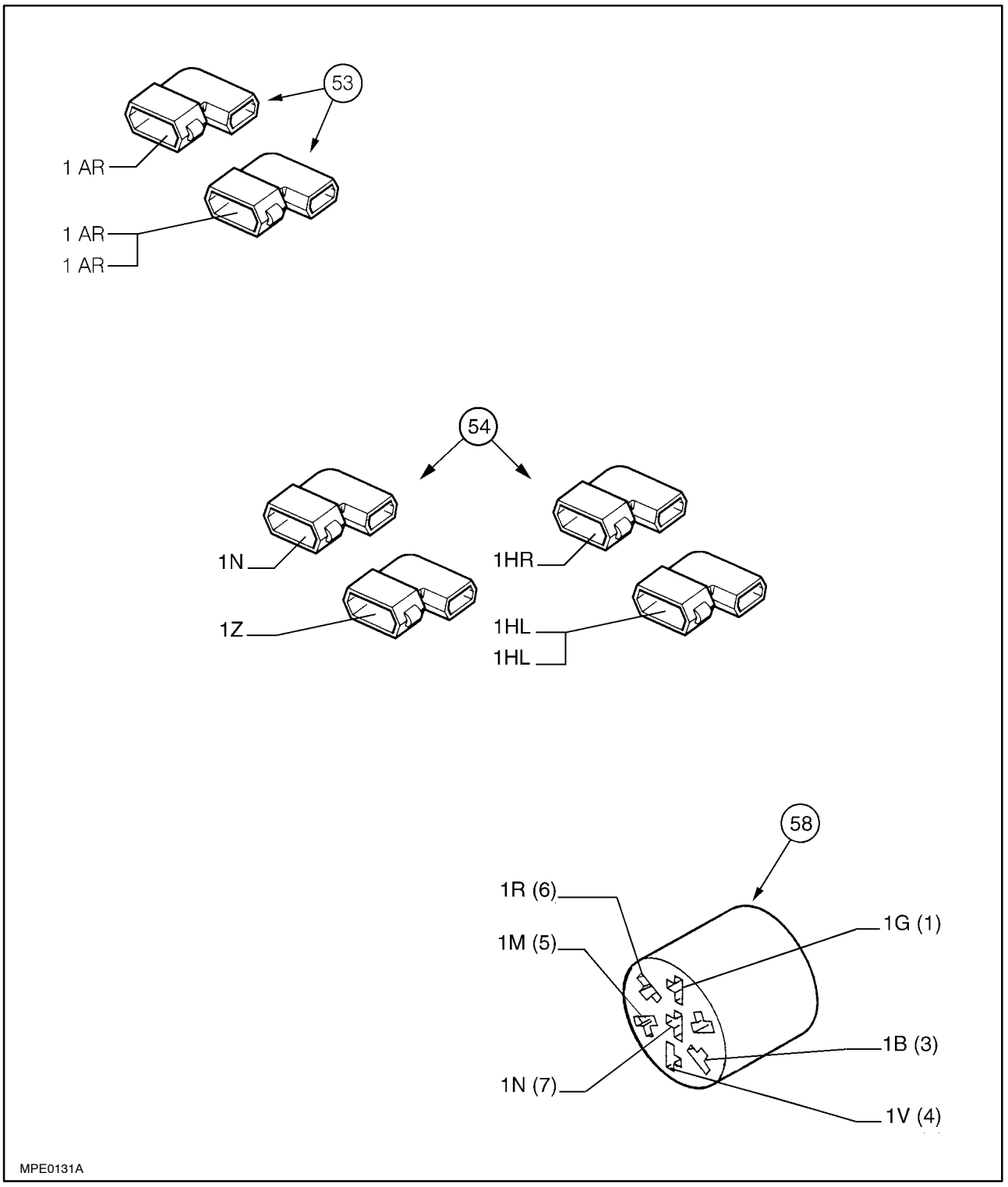
53 Trailer brake solenoid valves
54 Safety pressure switches and trailer brake circuit indicator
58 Seven-pole socket
62 PTO speed sensor
66 Differential lock indicator switch
67 Fuel level transmitter
68 Forward speed sensor
69 Differential lock solenoid valve
70 4WD indicator pressure switch
71 Rear PTO solenoid valve
72 4WD solenoid valve
79 Transmission side system connection (48 PIN)
131 Connection for 7-pole connector

▲ See diagrams M and N.

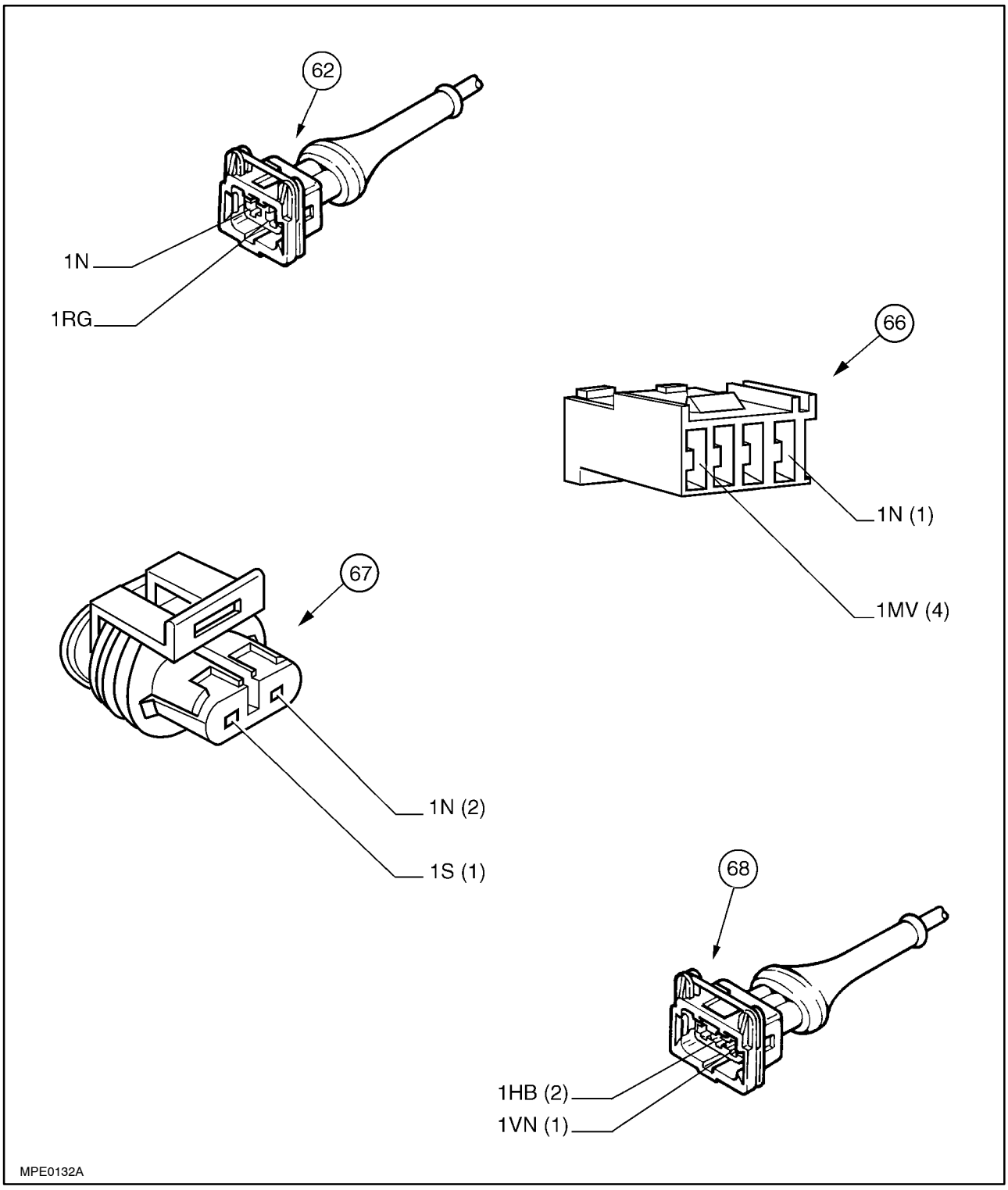
TRANSMISSION CIRCUIT (Version with Power Shuttle) - DIAGRAM O



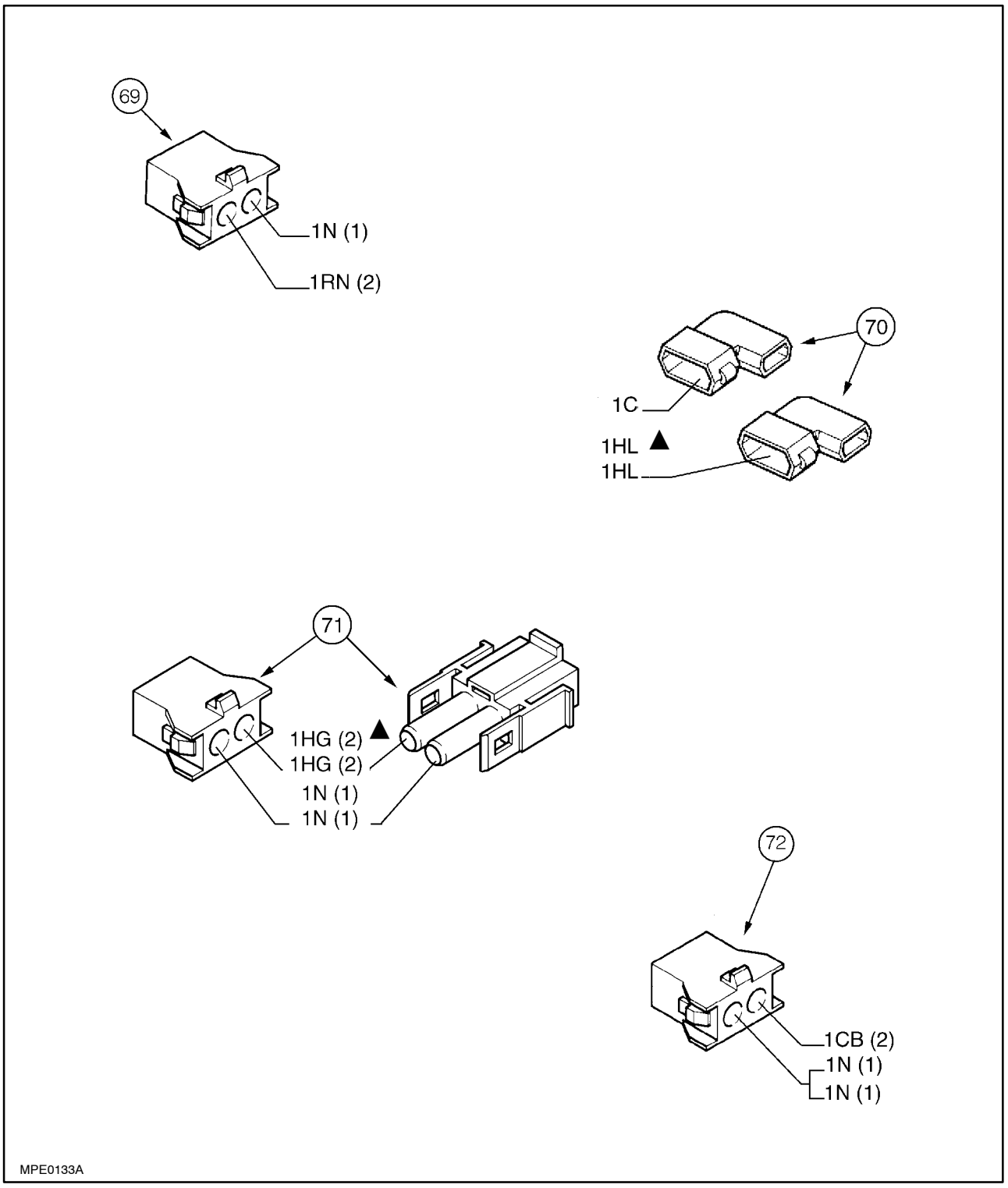
MPD3125A


53
1 AR
1 AR
1 AR
54
1N
1Z
1HR
1HL
1HL
58
1R (6)
1M (5)
1N (7)
1G (1)
1B (3)
1V (4)
MPE0131A

87

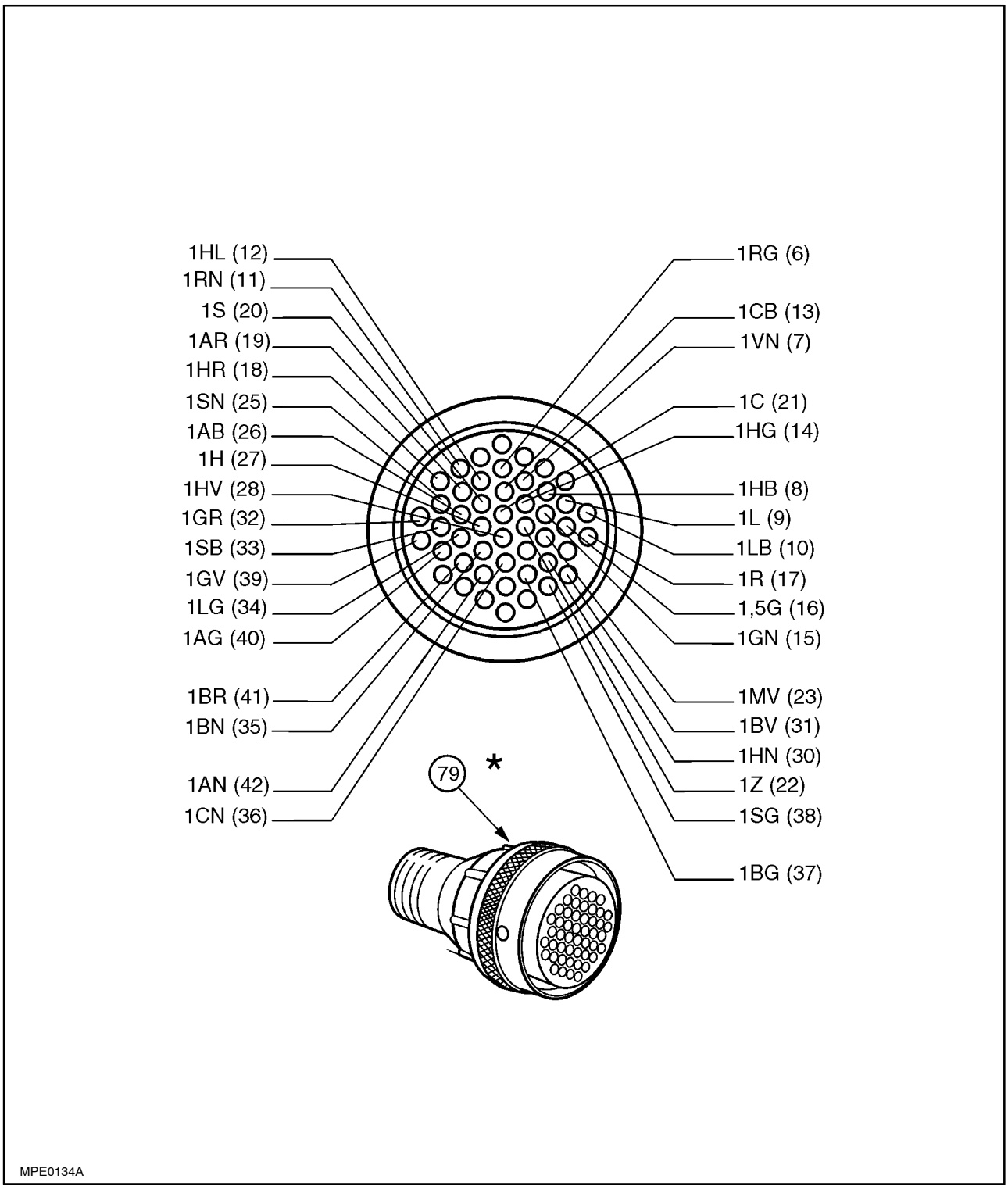


88



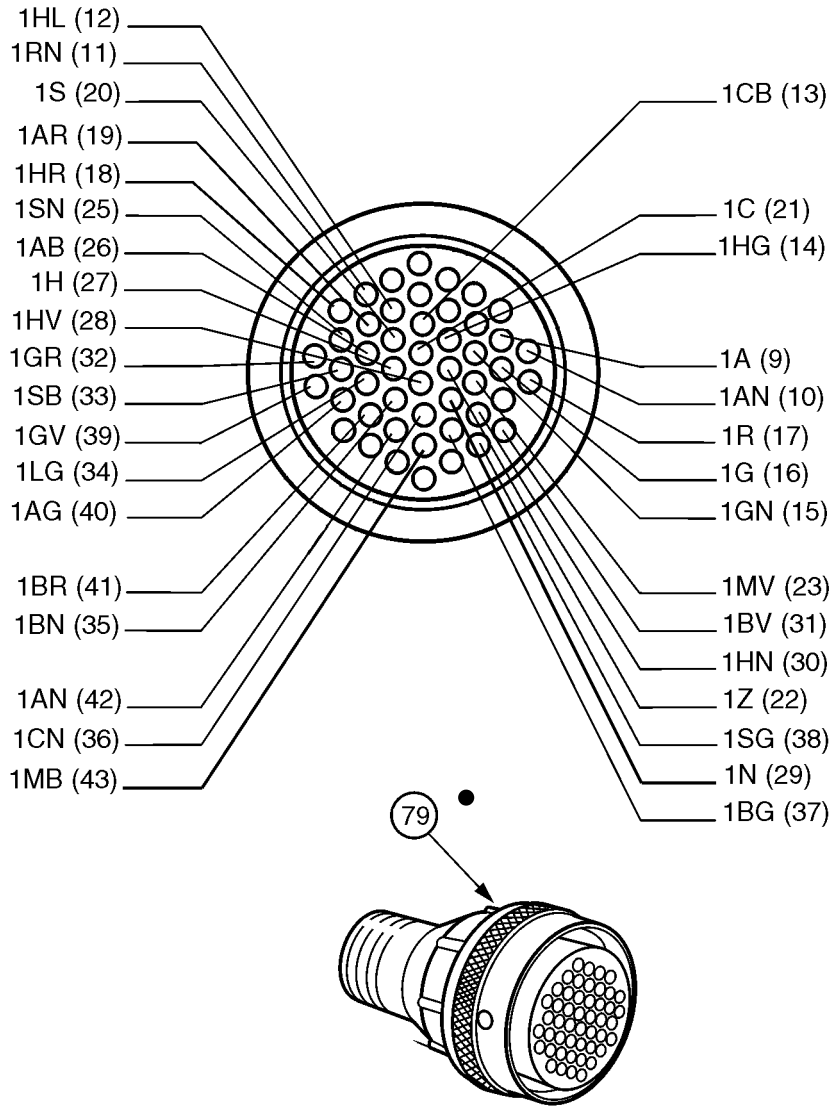
89

▲ Version with Dual Command (2 Speed Power Shift)



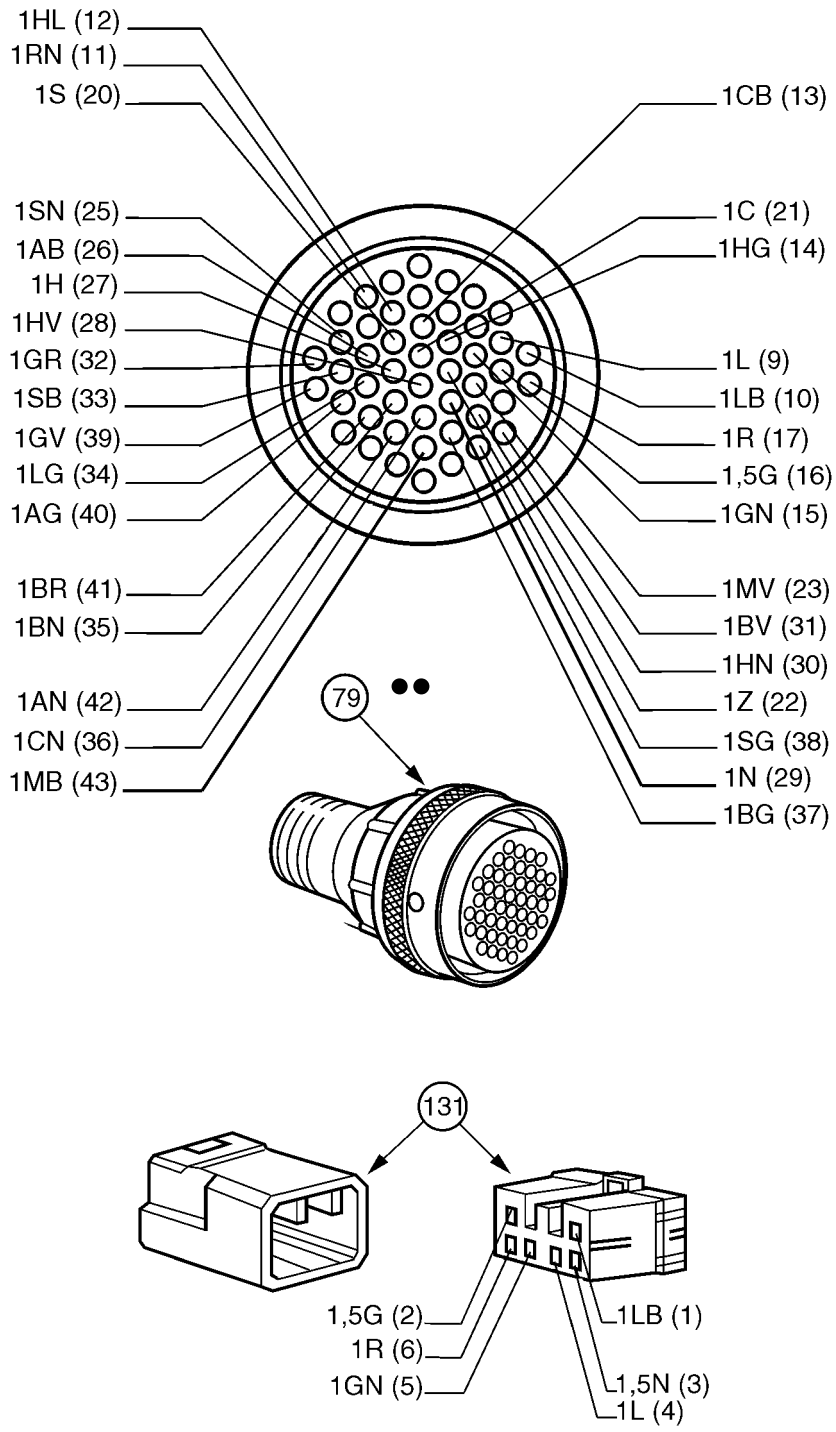
90

* Version with cab



91

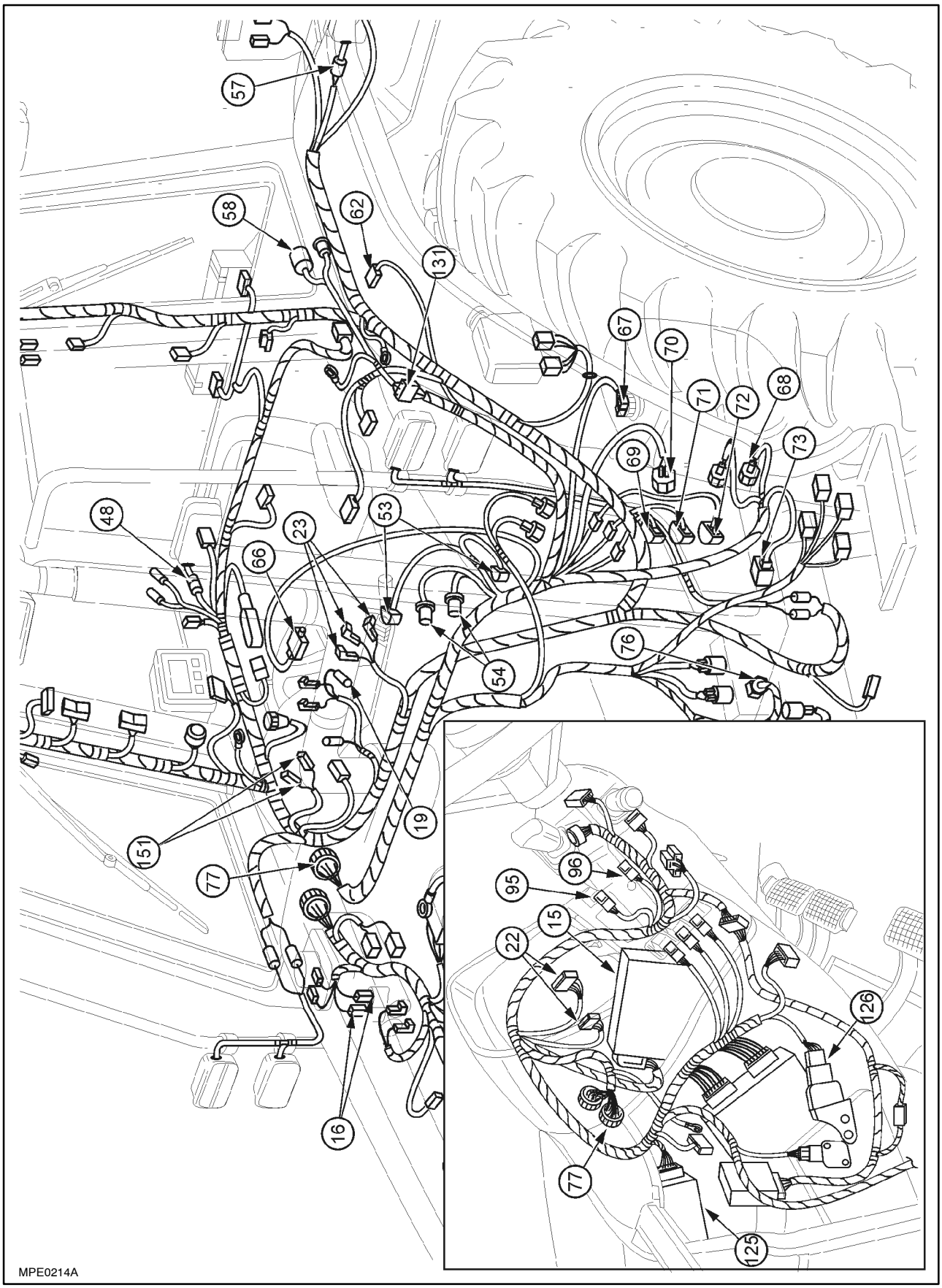
- Version without cab (ISO)



92

●● Version without cab (NASO)

WIRING DIAGRAMS P - Q - R/1 - R/2



93

DIFFERENTIAL LOCK AND BRAKE LIGHTS CIRCUIT [Version with DUAL COMMAND (2 SPEED POWER SHIFT)] (Diagram P)

15 Fuses and relay control unit
- F12 Trailer brake circuit, instruments, seat safety circuit
- F17 4WD, differential lock circuit
- F21 Brake lights, seat circuit
- C Differential lock circuit
- D Brake lights circuit
- VII Differential lock and brake lights circuit
- X Differential lock circuit

16 Brake lights switches

19 Dual Command (2 Speed Power Shift) control switch

22 Instrument panel
- I Handbrake ON (with starter key inserted)
- z Trailer brake ON

48 RH tail light

57 LH tail light

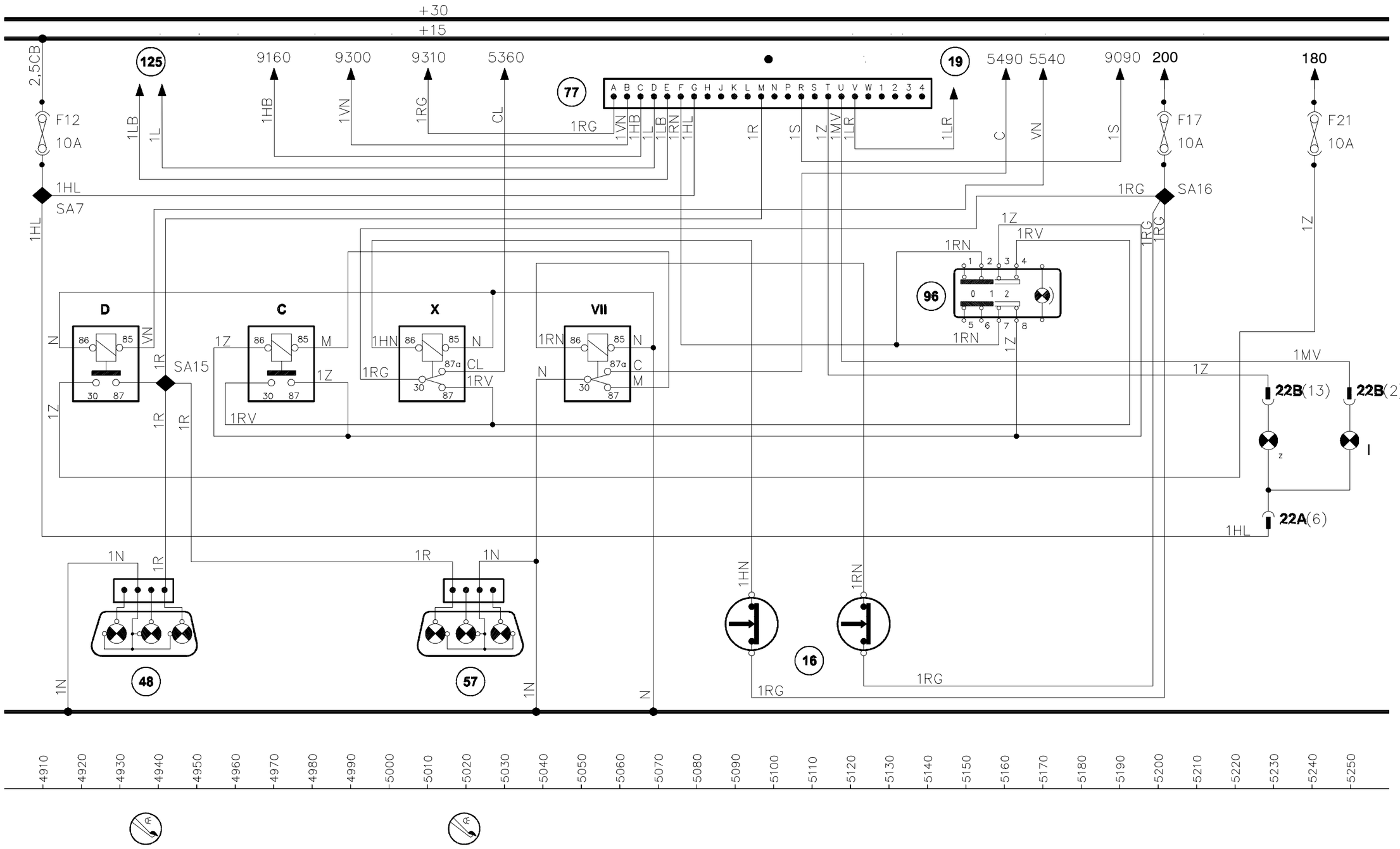
77 Transmission side system connection (24 PIN)

96 Differential lock switch

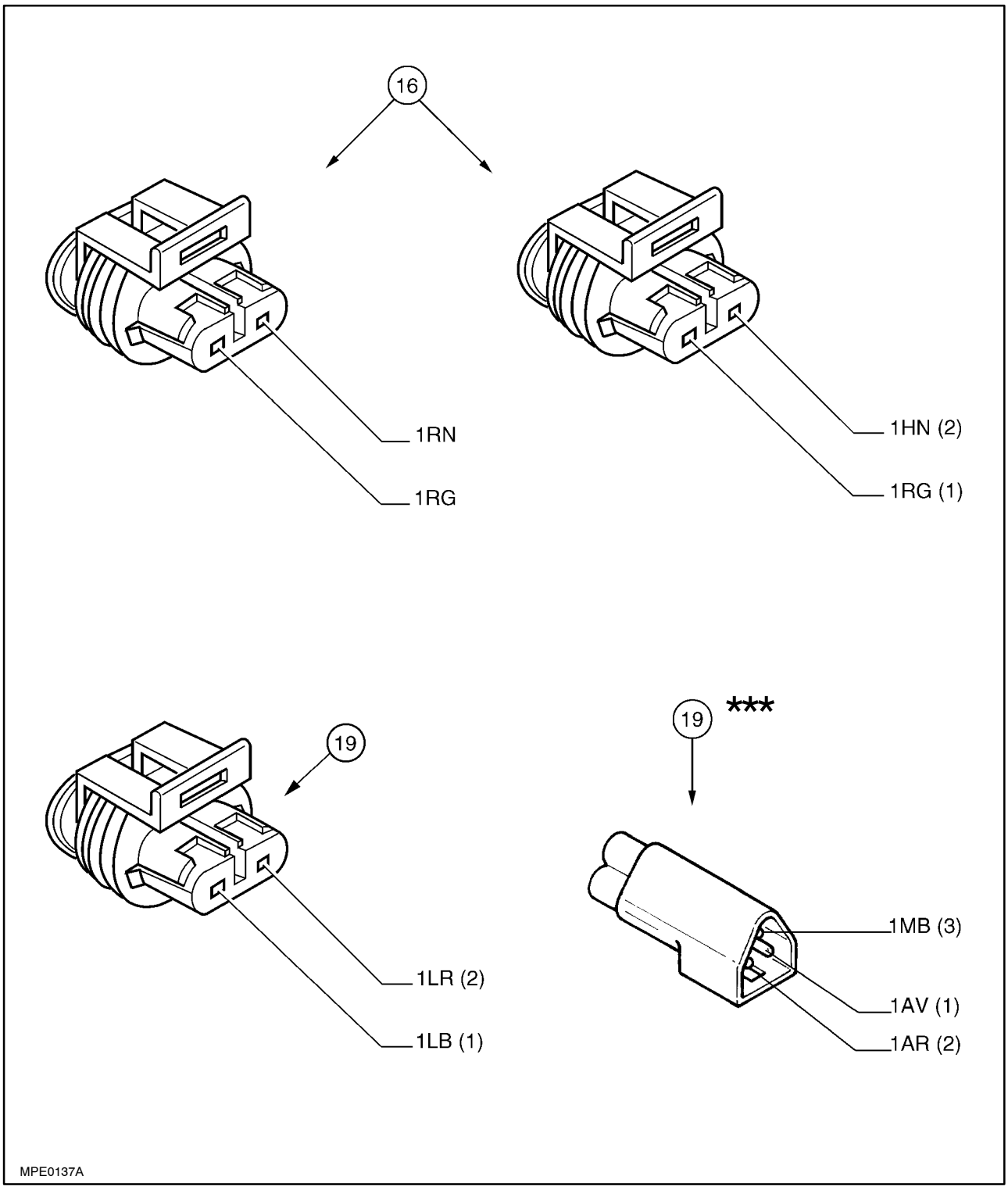
125 Electronic flasher

● See Diagrams R/1 and R/2.

DIFFERENTIAL LOCK AND BRAKE LIGHTS CIRCUIT [Version with DUAL COMMAND (2 SPEED POWER SHIFT)] - DIAGRAM P

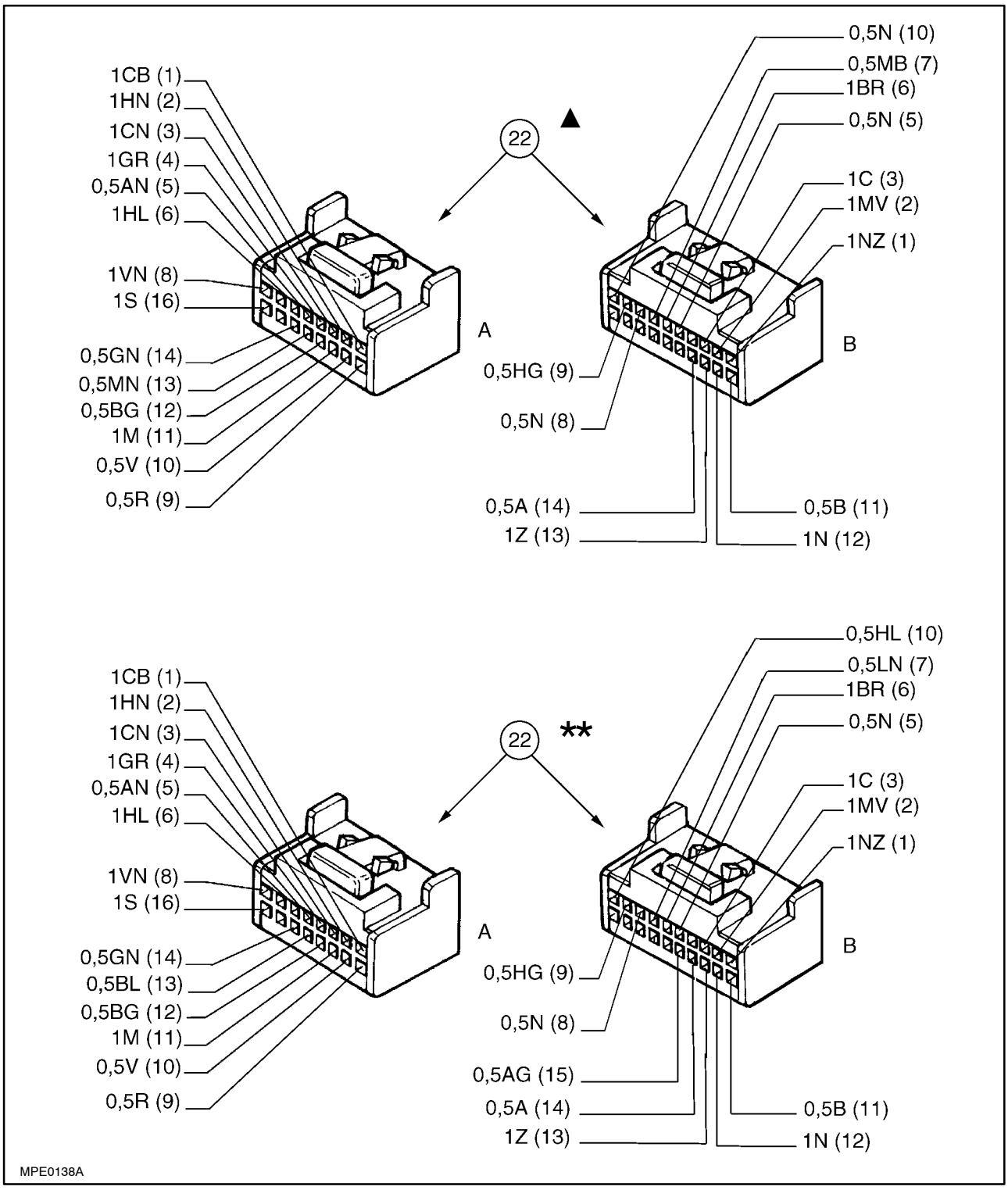


MPD3126A



94

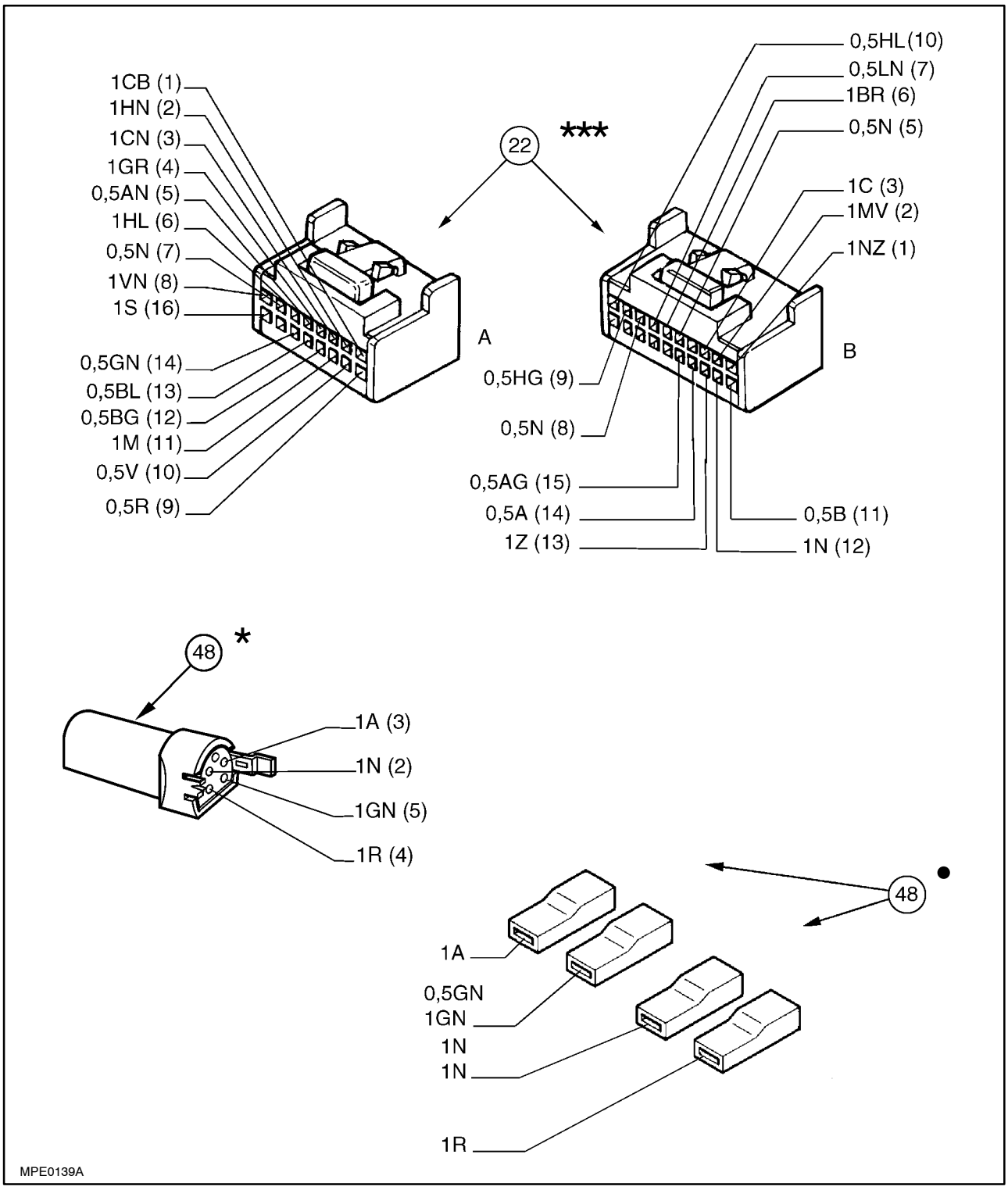
*** Power Shuttle version



95

▲ Version with Dual Command (2 Speed Power Shift)

** Version without cab

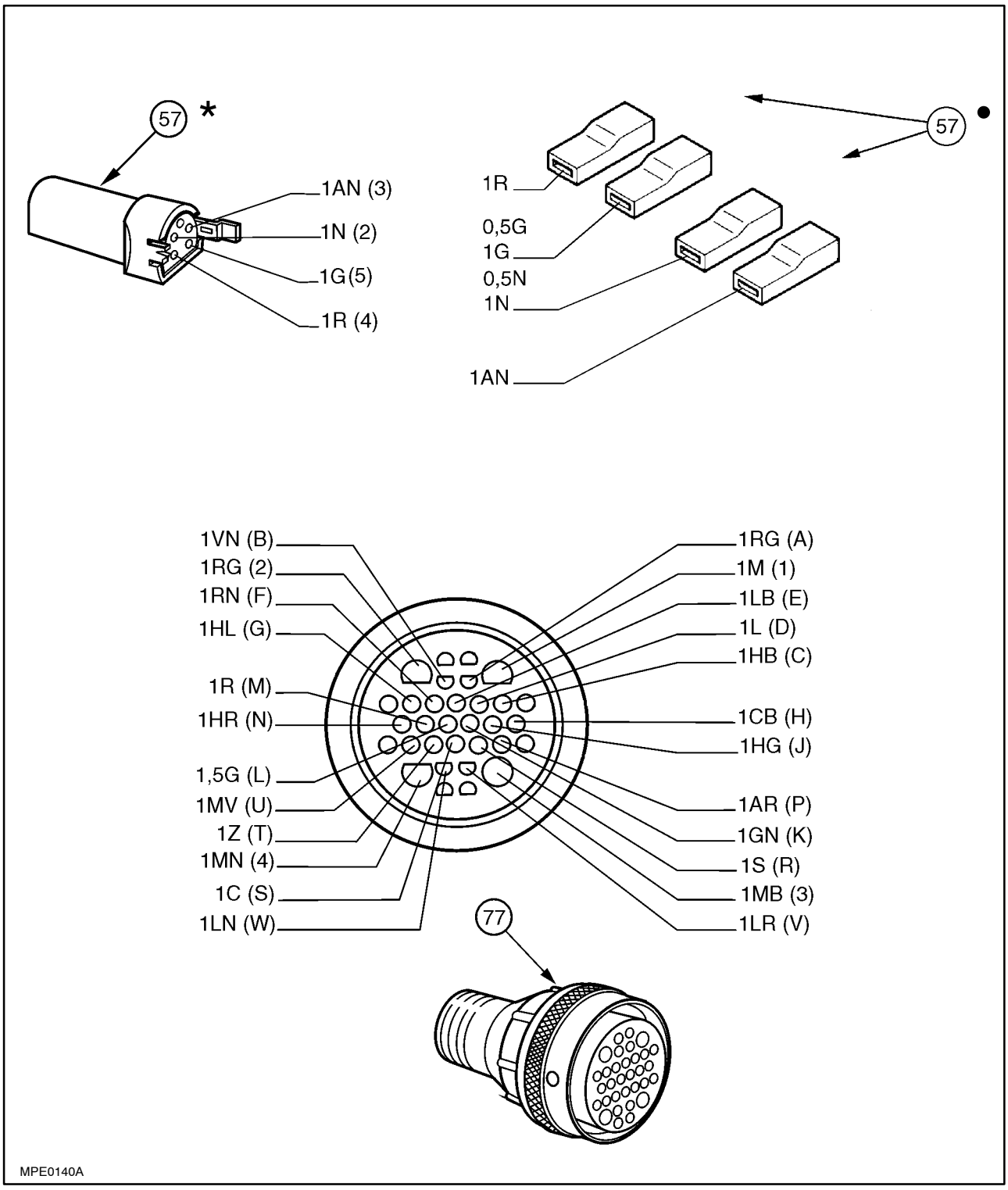


96

* Version with cab

*** Power Shuttle version

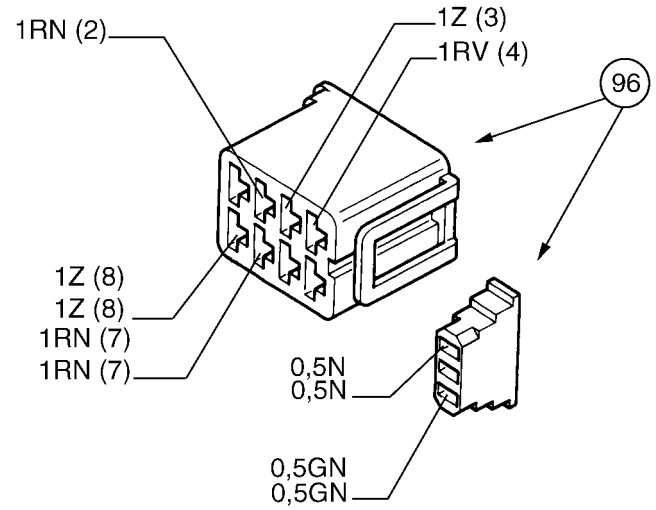
• Version without cab (ISO)

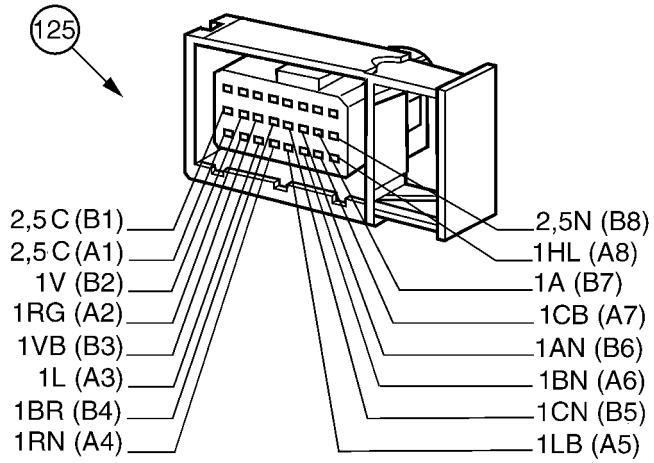


97

* Version with cab

• Version without cab (ISO)


1RN (2)
1Z (3)
1RV (4)
96
1Z (8)
1Z (8)
1RN (7)
1RN (7)
0,5N
0,5N
0,5GN
0,5GN


125
2,5 C (B1)
2,5 C (A1)
1V (B2)
1RG (A2)
1VB (B3)
1L (A3)
1BR (B4)
1RN (A4)
2,5N (B8)
1HL (A8)
1A (B7)
1CB (A7)
1AN (B6)
1BN (A6)
1CN (B5)
1LB (A5)

MPE0141A

98

4WD, TRAILER BRAKE, PTO CIRCUIT [Version with DUAL COMMAND (2 SPEED POWER SHIFT)] (Diagram Q)

15 Fuses and relay control unit
- F2 Dual Command (2 Speed Power Shift) circuit
- F12 Trailer brake circuit, instruments, seat safety circuit
- F17 4WD, differential lock circuit
- F18 Rear power take-off circuit
- F23 Starter safety circuit
- E Trailer brake circuit
- F Electrohydraulic PTO circuit
- G Electrohydraulic PTO circuit
- H Trailer brake circuit
- I Starter motor circuit
- II Electrohydraulic 4WD circuit
- IX Dual Command (2 Speed Power Shift) circuit

22 Instrument panel
- h 4WD ON
- l Handbrake ON (with starter key inserted)
- s PTO ON

77 Transmission side system connection (24 PIN)

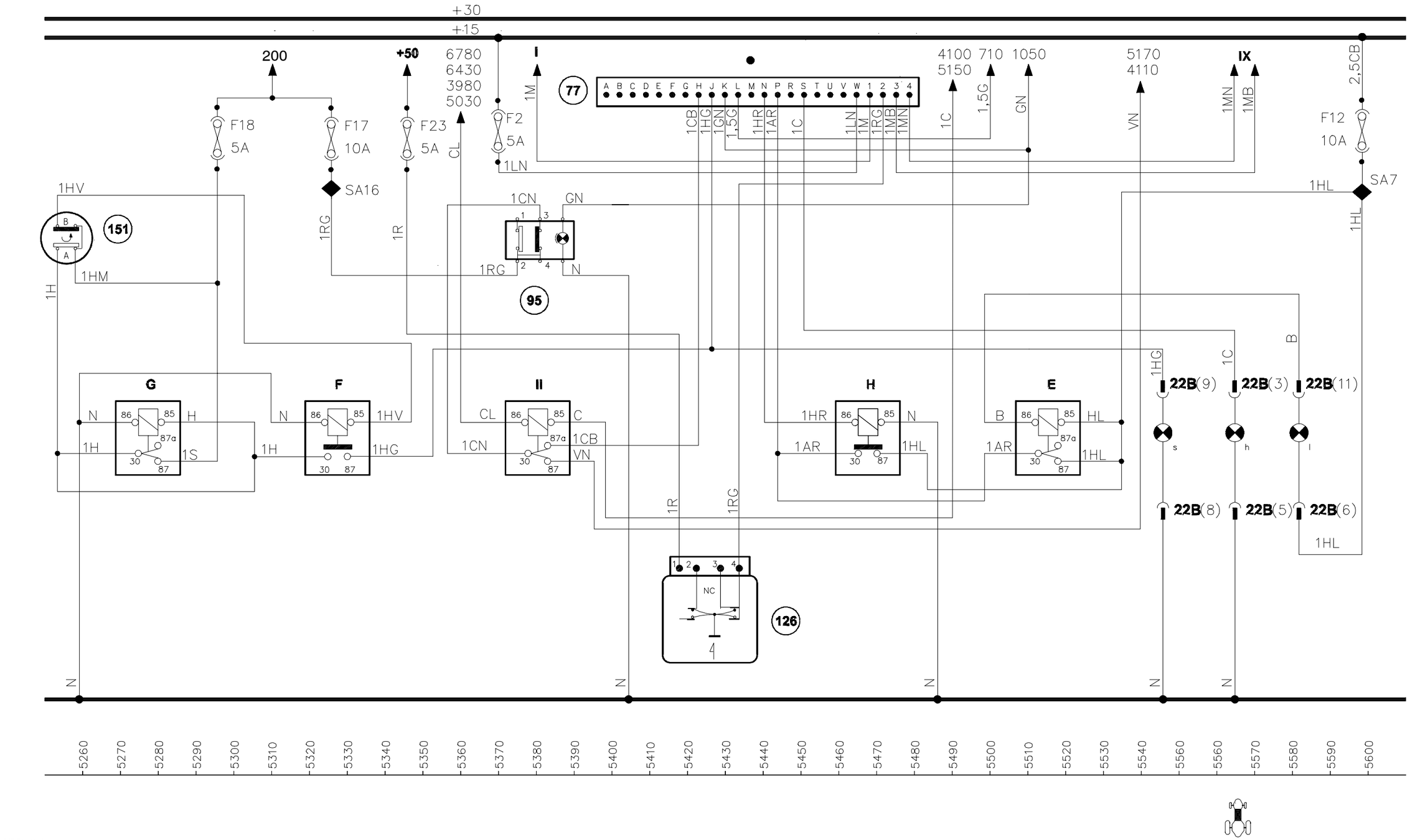
95 4WD control switch

126 Clutch pedal switch

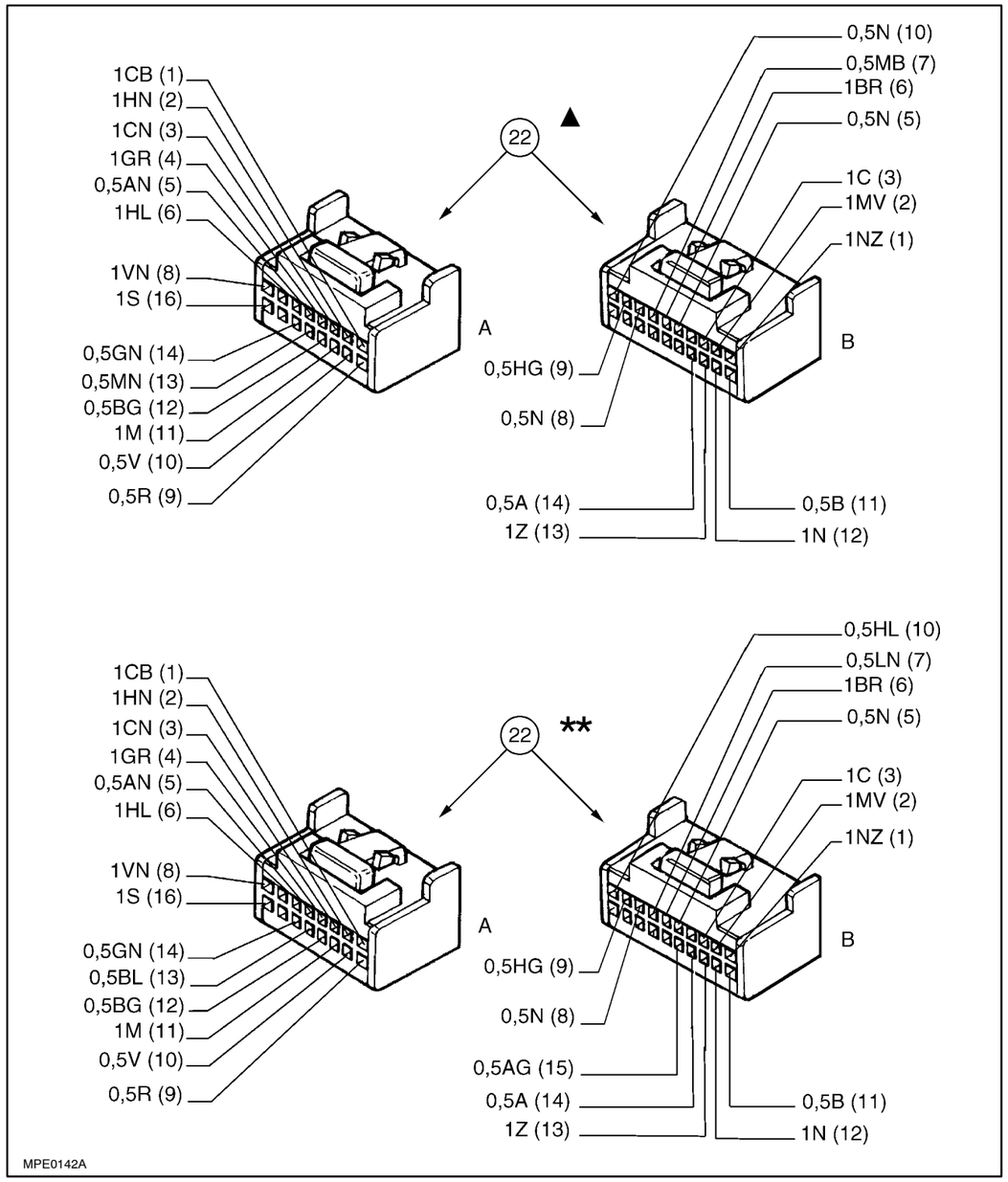
151 Rear PTO switch

● See Diagrams R/1 and R/2.

4WD, TRAILER BRAKE, PTO CIRCUIT [Version with DUAL COMMAND (2 SPEED POWER SHIFT)] - DIAGRAM Q



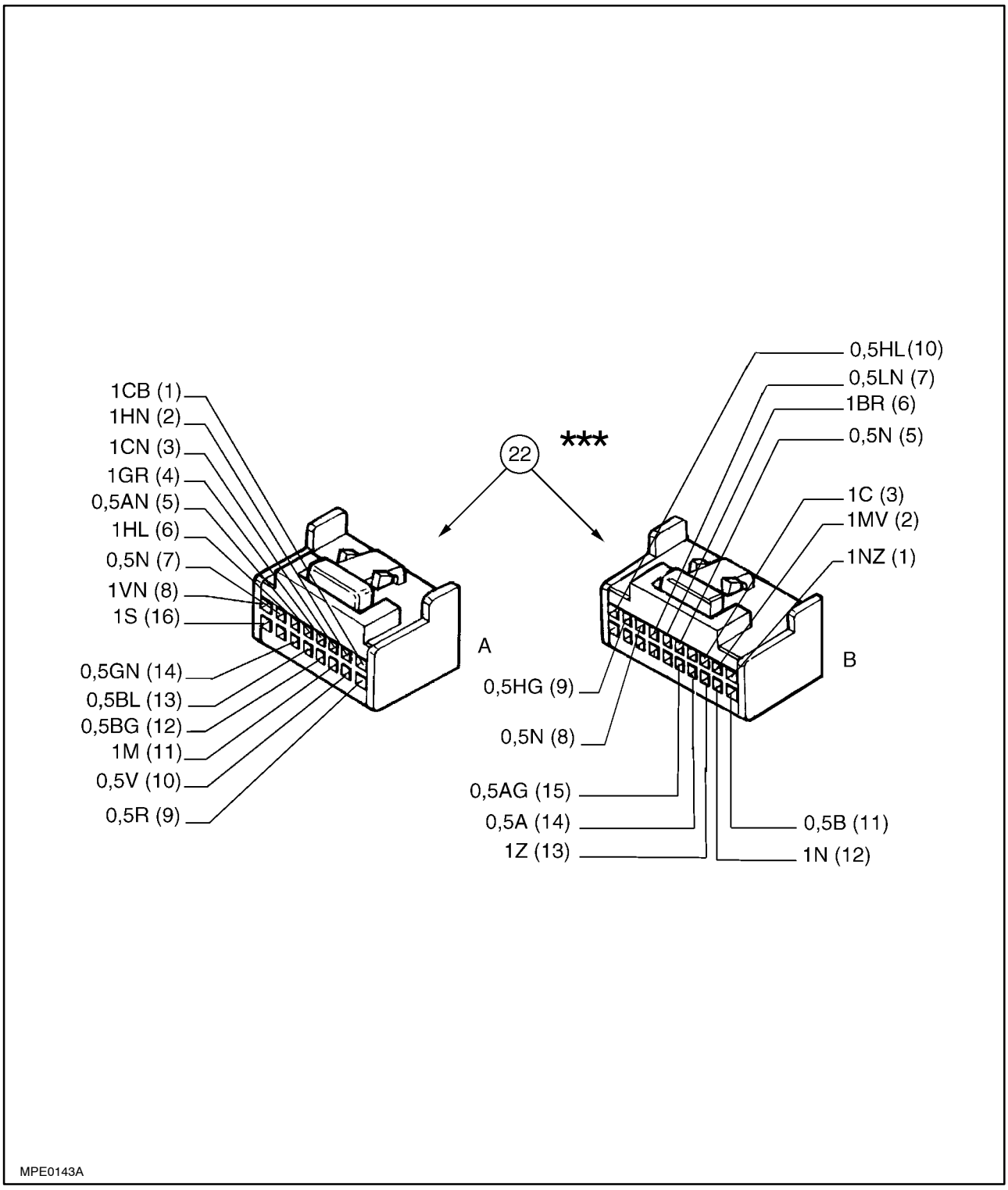
MPD3127A



99

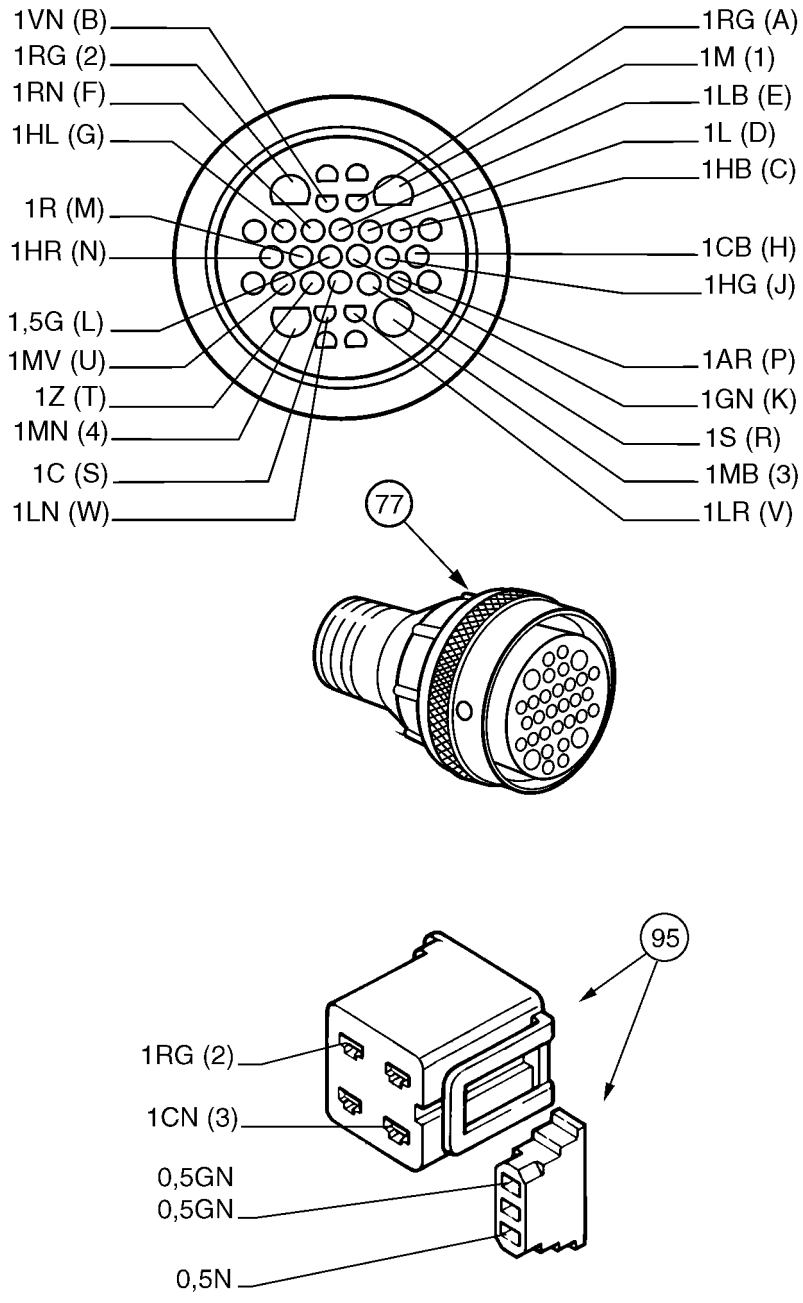
▲ Version with Dual Command (2 Speed Power Shift)

** Version without cab

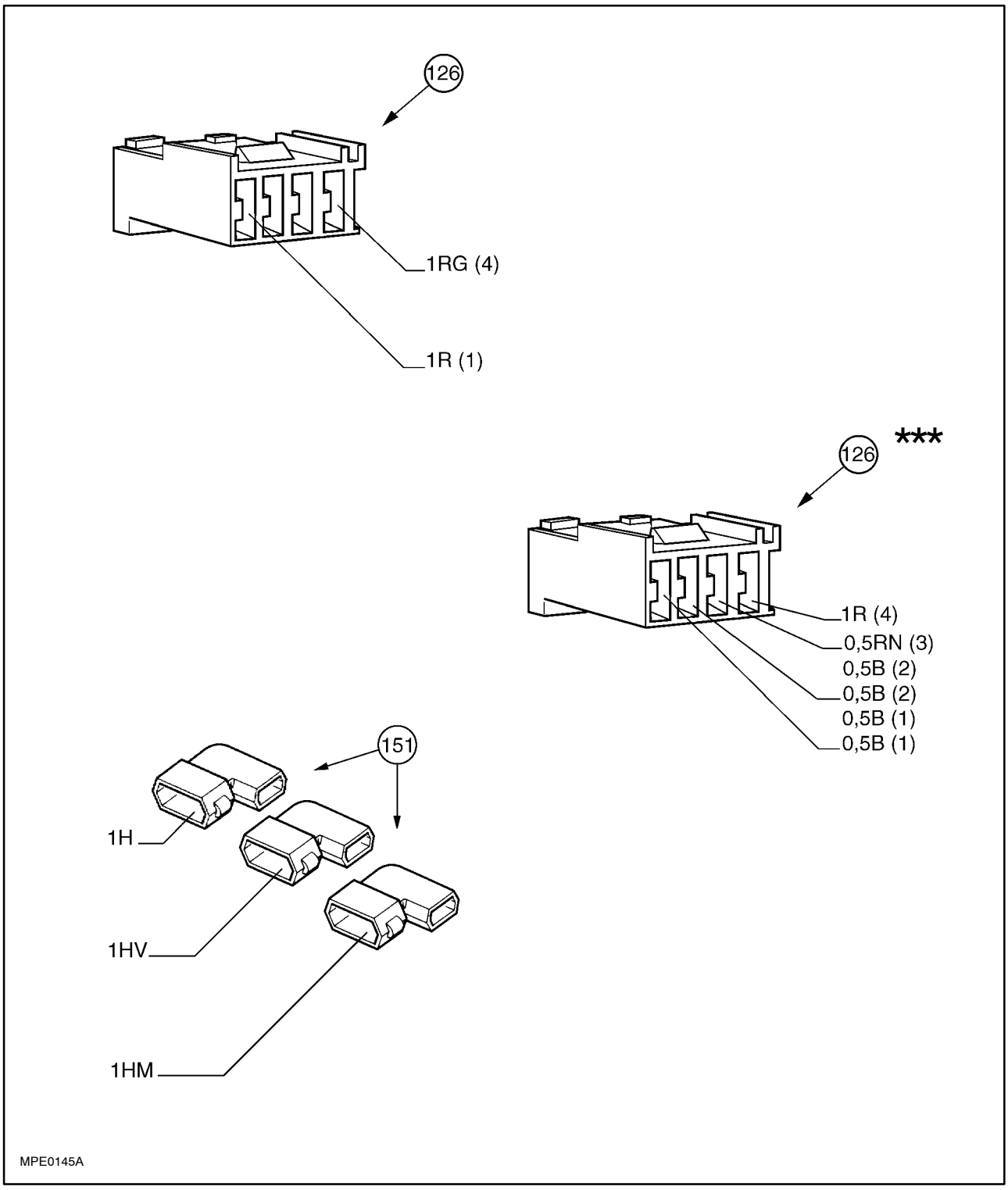


100

*** Power Shuttle version


1VN (B)
1RG (2)
1RN (F)
1HL (G)
1R (M)
1HR (N)
1,5G (L)
1MV (U)
1Z (T)
1MN (4)
1C (S)
1LN (W)
1RG (A)
1M (1)
1LB (E)
1L (D)
1HB (C)
1CB (H)
1HG (J)
1AR (P)
1GN (K)
1S (R)
1MB (3)
1LR (V)
77
95
1RG (2)
1CN (3)
0,5GN
0,5GN
0,5N
MPE0144A

101



102

*** Power Shuttle version

TRANSMISSION CIRCUIT
[Version with DUAL COMMAND (2 SPEED POWER SHIFT)]
(Diagram R/1)

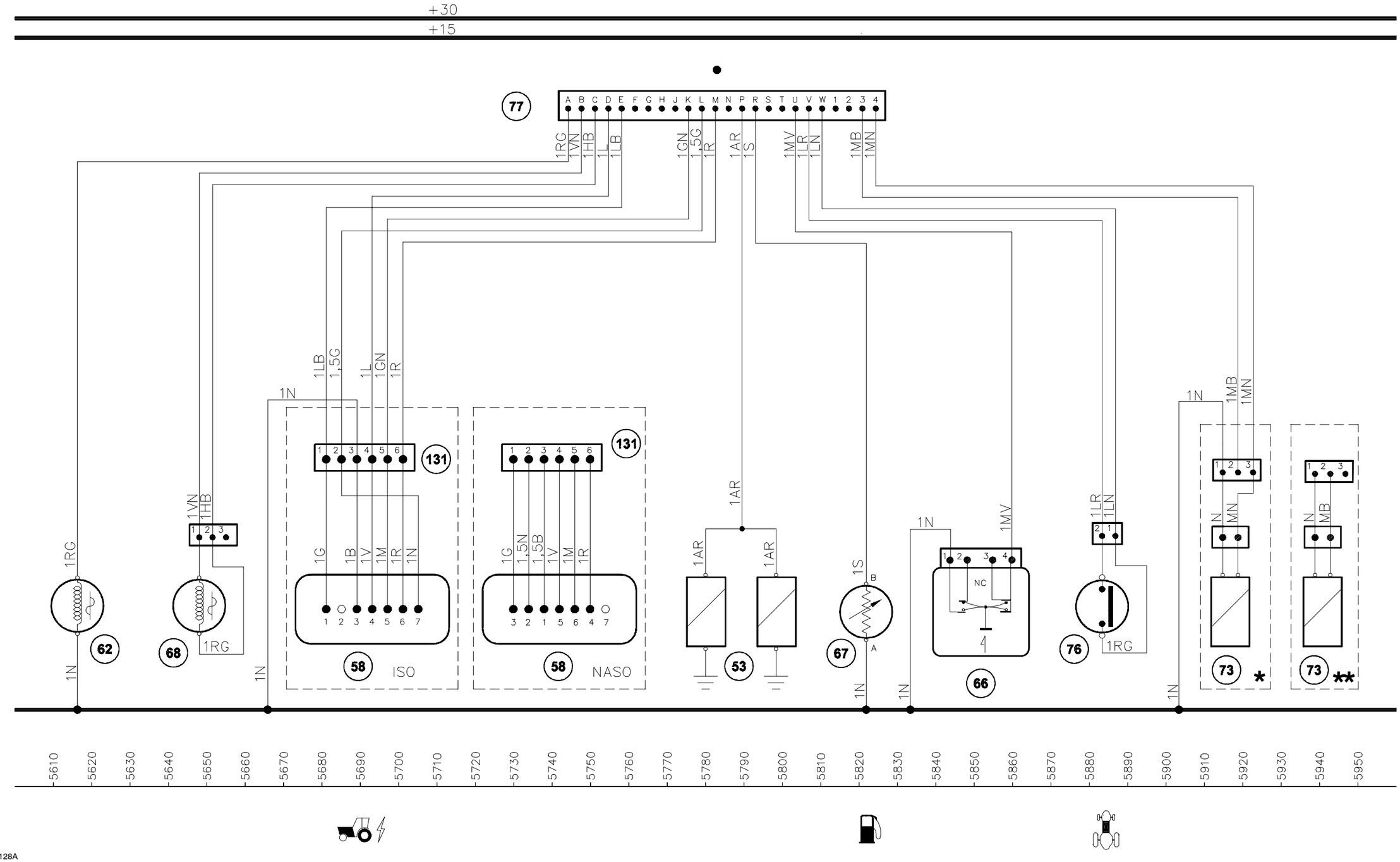
53 Trailer brake solenoid valve
58 Seven-pole socket
62 PTO speed sensor
66 Differential lock indicator switch
67 Fuel level transmitter
68 Forward speed sensor
73 Dual Command (2 Speed Power Shift) solenoid valve
76 Reverser lever switch for Dual Command (2 Speed Power Shift)
77 Transmission side system connection (24 PIN)
131 Connection for 7-pole connector

***** 40 Km/h version.

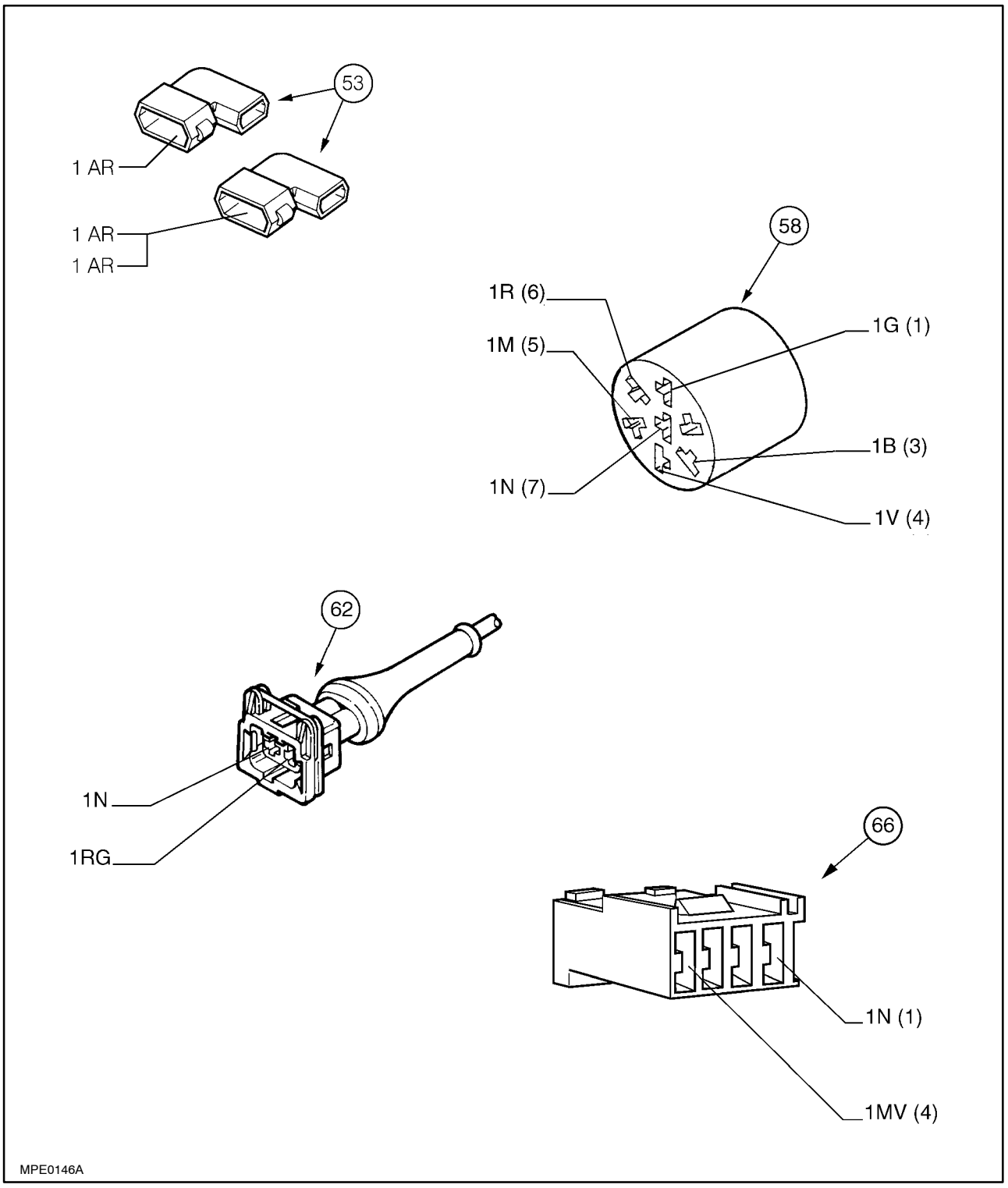
****** 30 Km/h version.

● See diagrams P and Q.

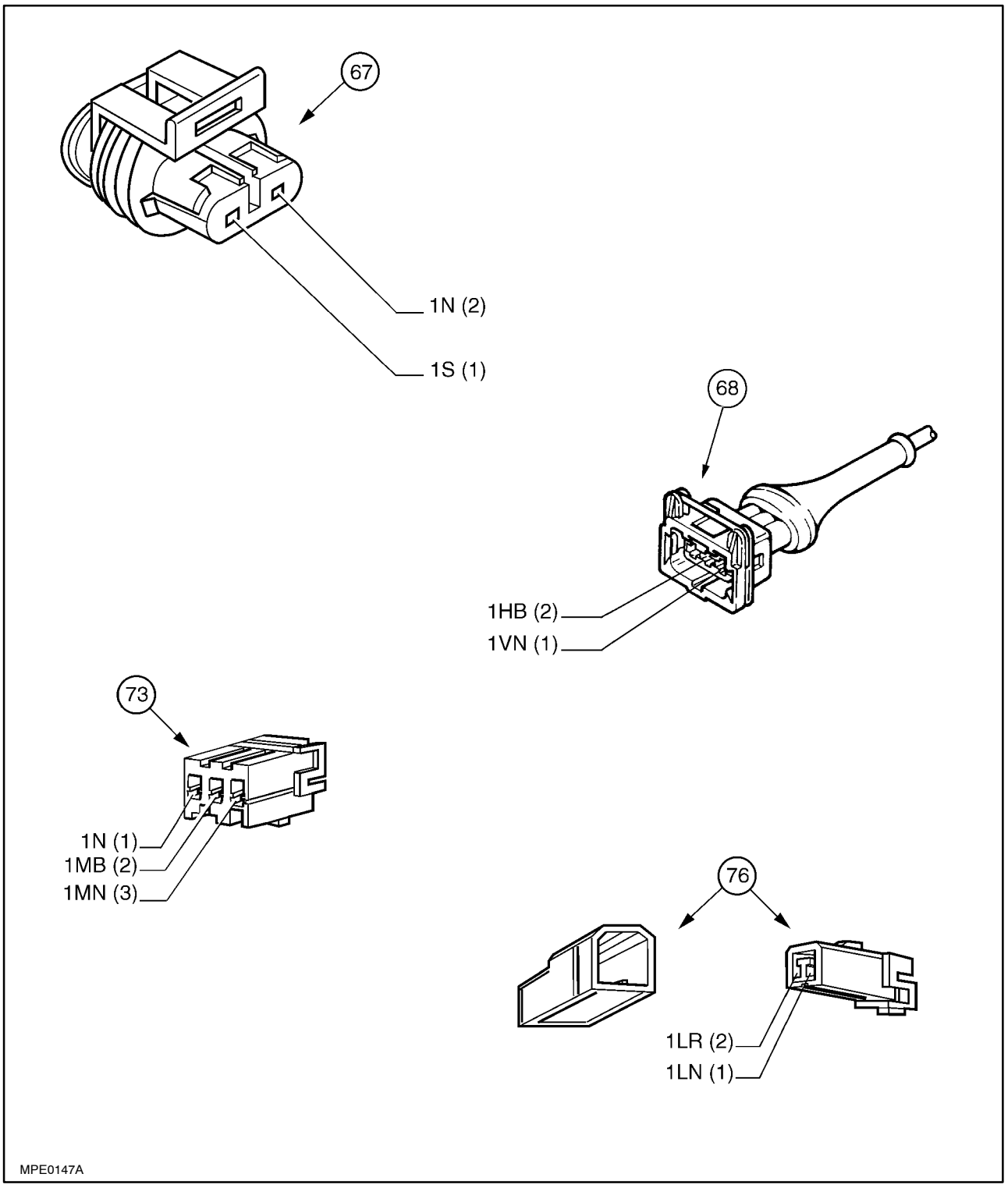
TRANSMISSION CIRCUIT [Version with DUAL COMMAND (2 SPEED POWER SHIFT)] - DIAGRAM R/1



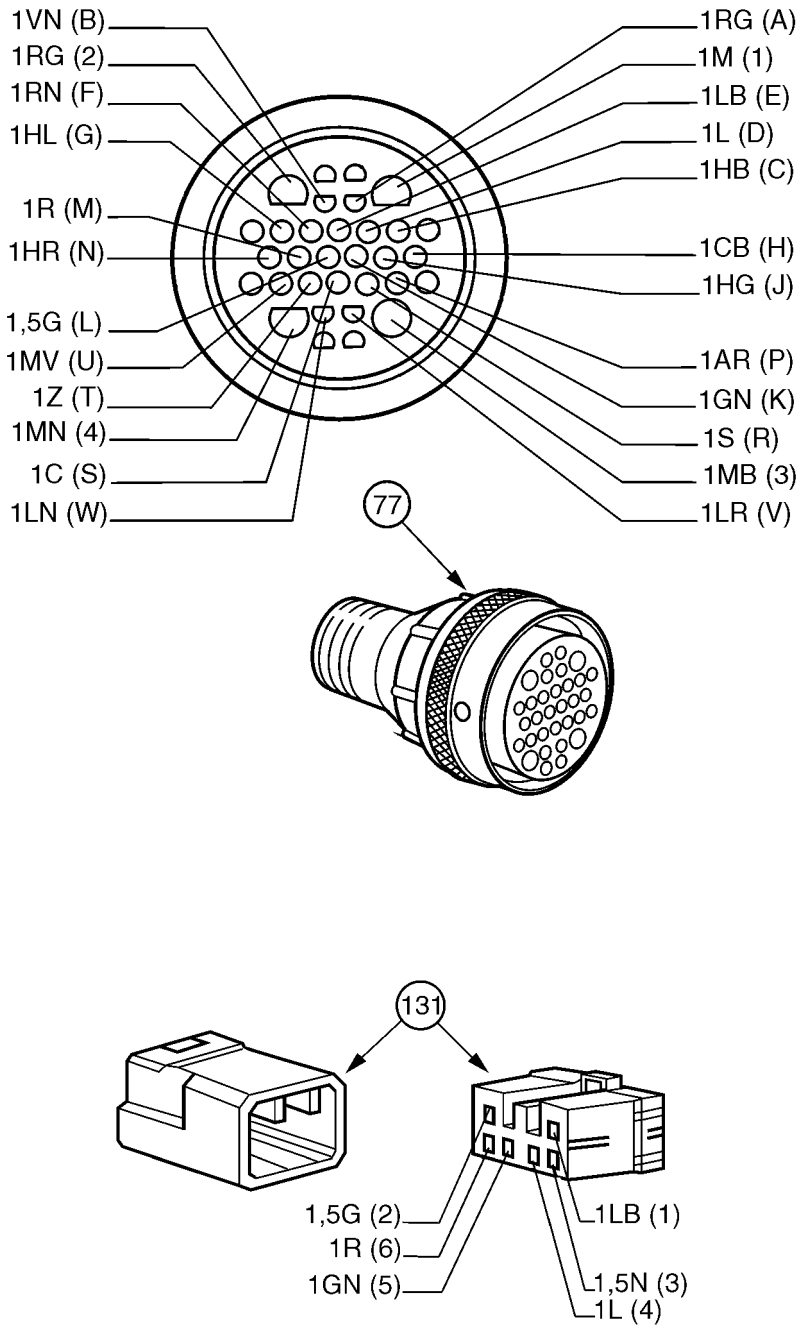
MPD3128A


53
1 AR
1 AR
1 AR
58
1R (6)
1M (5)
1N (7)
1G (1)
1B (3)
1V (4)
62
1N
1RG
66
1N (1)
1MV (4)
MPE0146A

103



104


1VN (B)
1RG (2)
1RN (F)
1HL (G)
1R (M)
1HR (N)
1,5G (L)
1MV (U)
1Z (T)
1MN (4)
1C (S)
1LN (W)
1RG (A)
1M (1)
1LB (E)
1L (D)
1HB (C)
1CB (H)
1HG (J)
1AR (P)
1GN (K)
1S (R)
1MB (3)
1LR (V)
77
131
1,5G (2)
1R (6)
1GN (5)
1LB (1)
1,5N (3)
1L (4)
MPE0148A

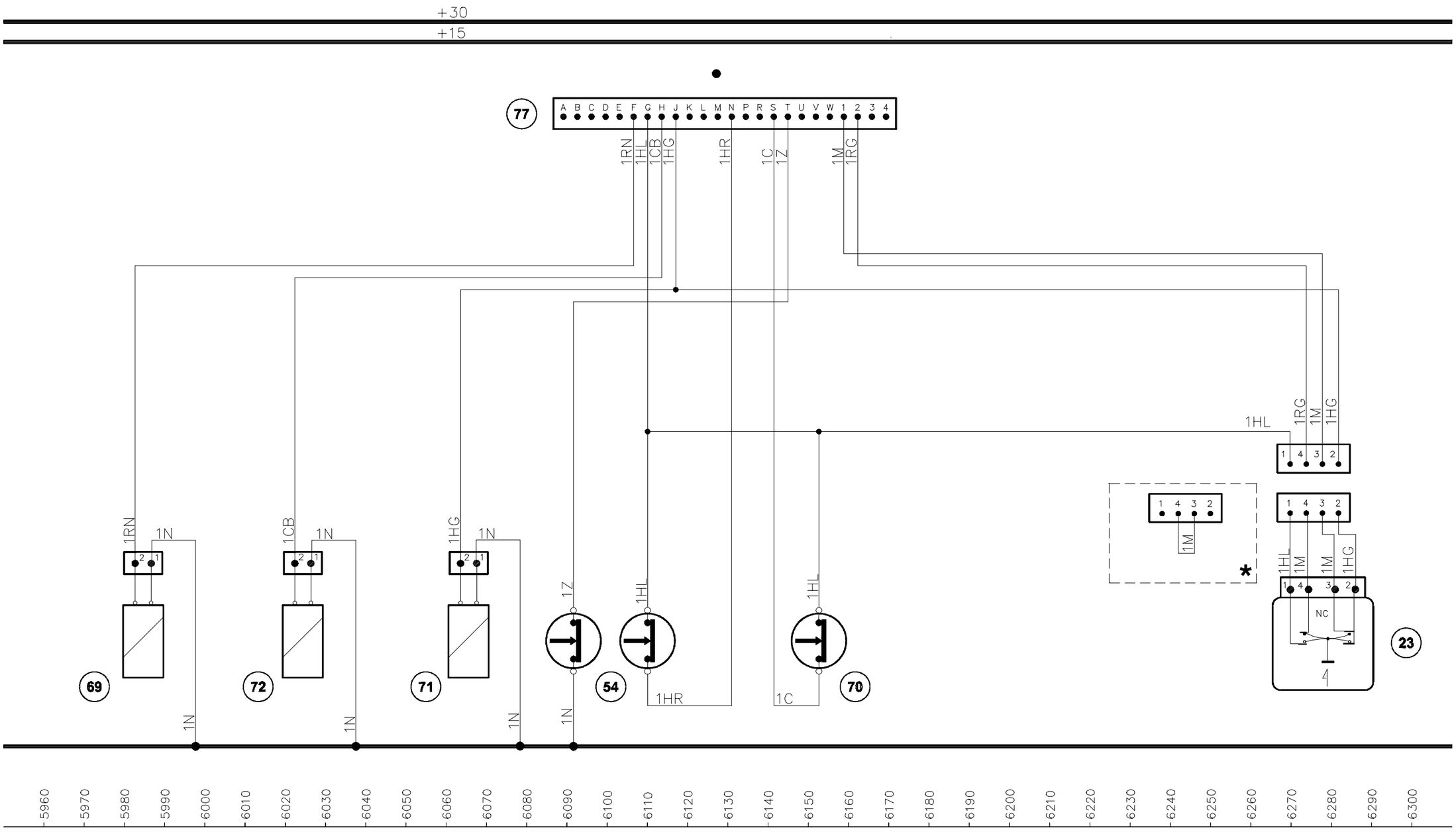
105

TRANSMISSION CIRCUIT
[Version with DUAL COMMAND (2 SPEED POWER SHIFT)]
(Diagram R/2)

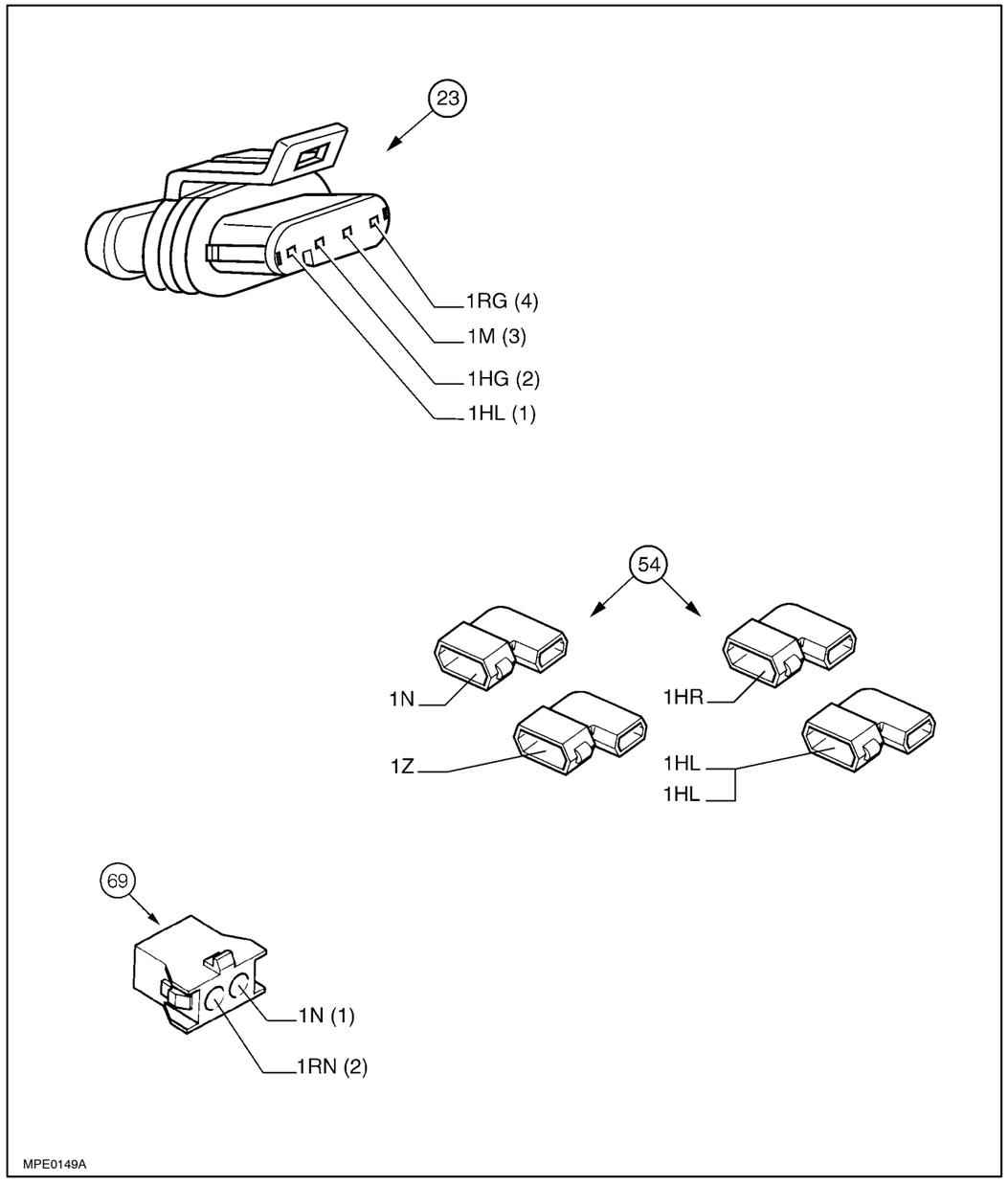
23 Electrohydraulic PTO switch
54 Safety pressure switches and trailer brake circuit indicator
69 Differential lock solenoid valve
70 4WD indicator pressure switch
71 Rear PTO solenoid valve
72 4WD solenoid valve
77 Transmission side system connection (24 PIN)

* Jumper for mechanical PTO version.
● See diagrams P and Q.

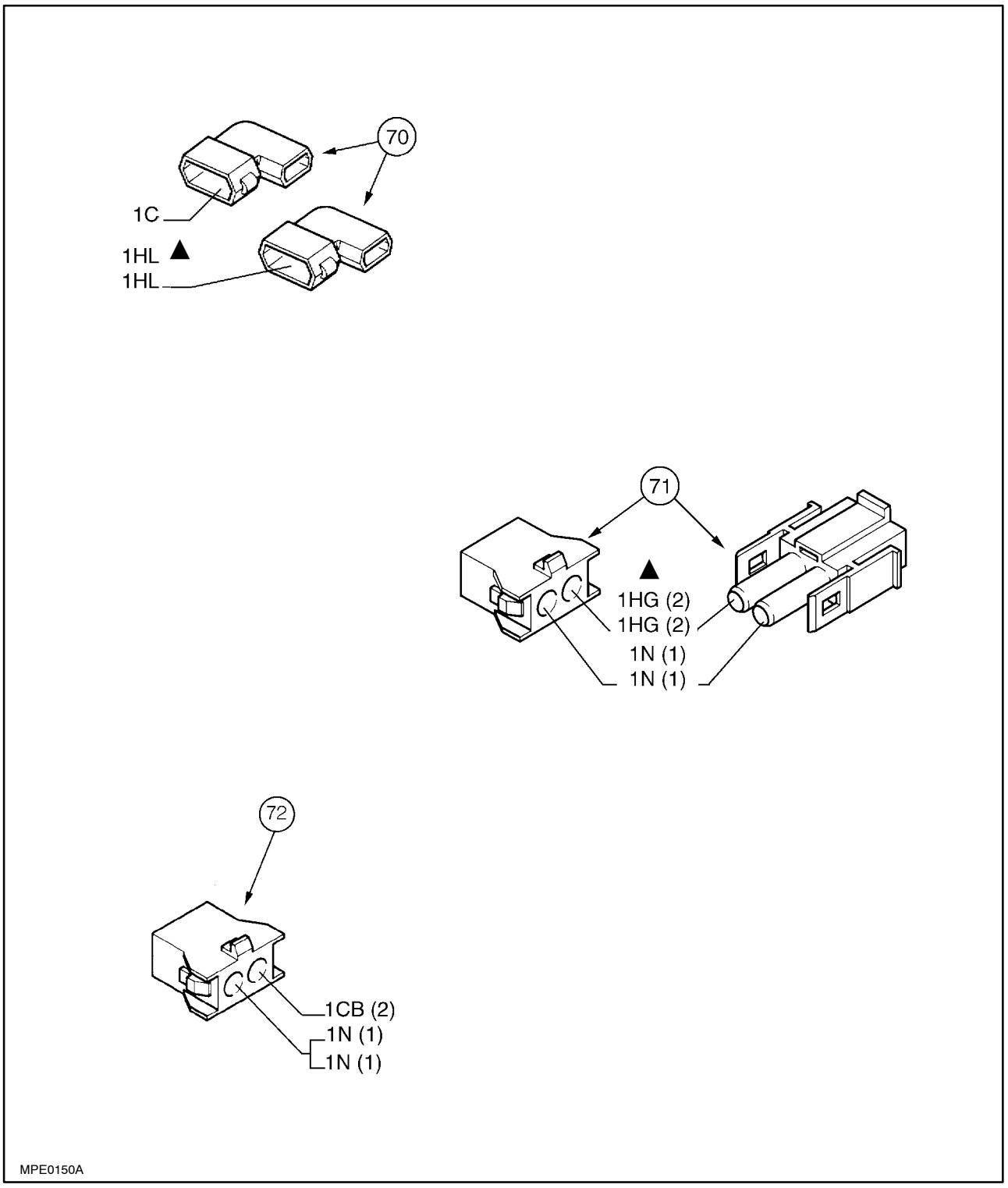
TRANSMISSION CIRCUIT [Version with DUAL COMMAND (2 SPEED POWER SHIFT)] - DIAGRAM R/2



MPD3129A

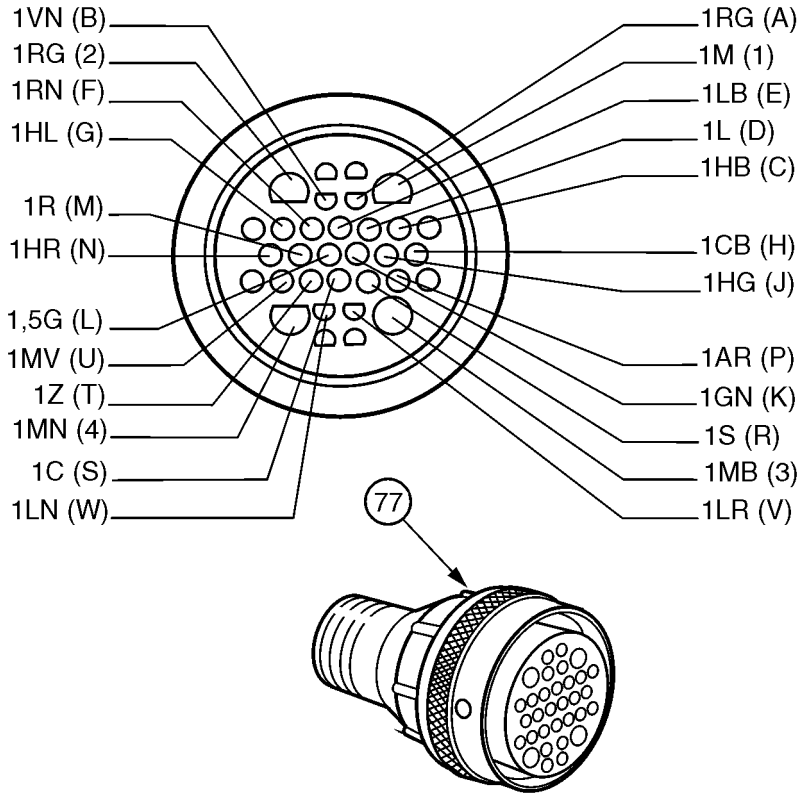


106



107

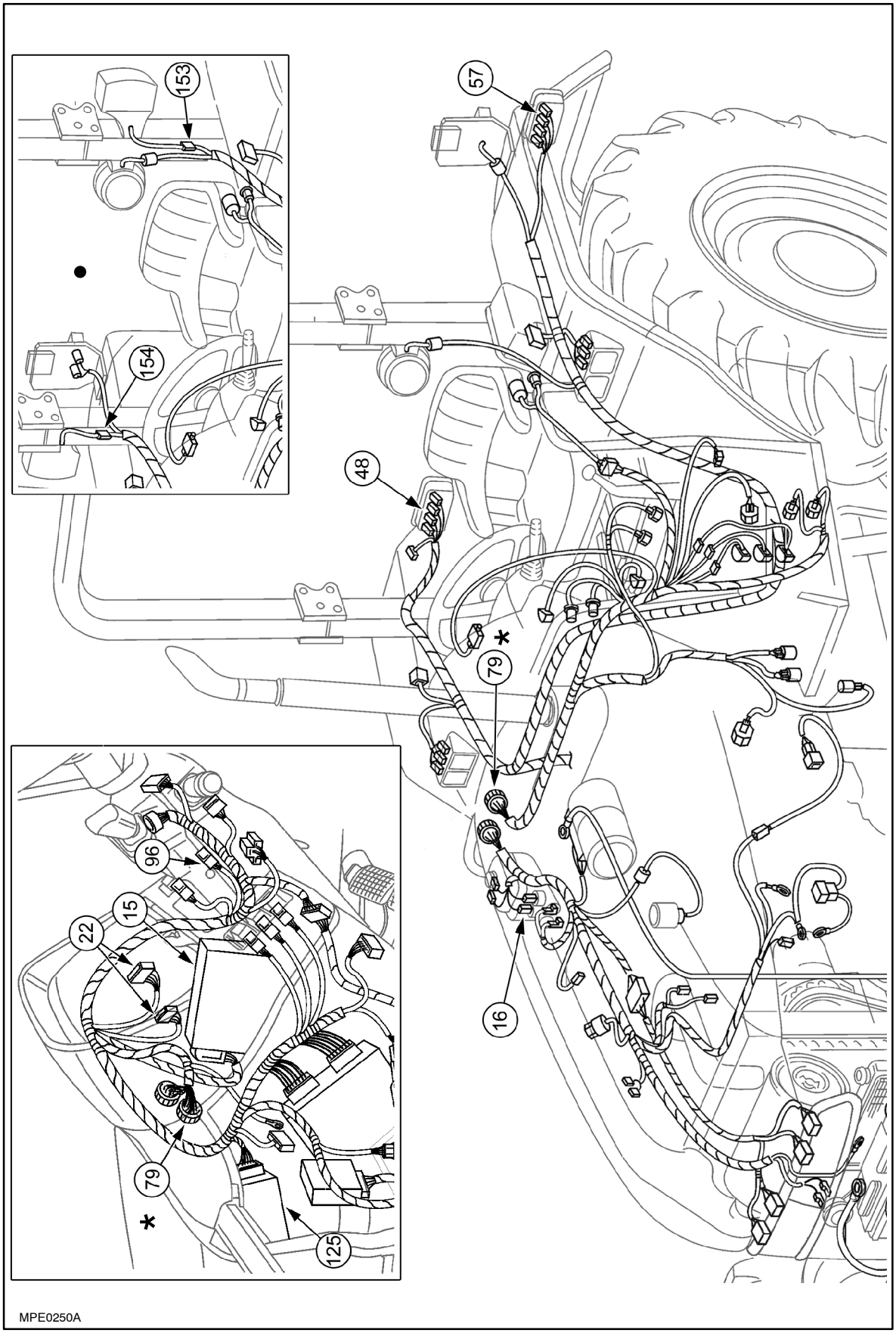
▲ Version with Dual Command (2 Speed Power Shift)



MPE0151A

108

WIRING DIAGRAMS S - T



• NASO version

* For cab versions with Power Shuttle (OHIO BILL CONFORMITY) and flatbed versions (ISO-NASO version).

DIFFERENTIAL LOCK AND BRAKE LIGHTS CIRCUIT
(Version without cab - ISO)
(Diagram S)

15 Fuses and relay control unit
- F12 Trailer brake circuit, instruments, operator alarm circuit
- F17 4WD, sediment unit, differential lock circuit
- F21 Brake lights
- C Differential lock and brake lights circuit
- D Brake lights circuit
- VII Differential lock and brake lights circuit
- X Differential lock circuit

16 Brake lights switches

22 Instrument panel
- i Differential lock
- z Trailer brake ON

48 RH tail light

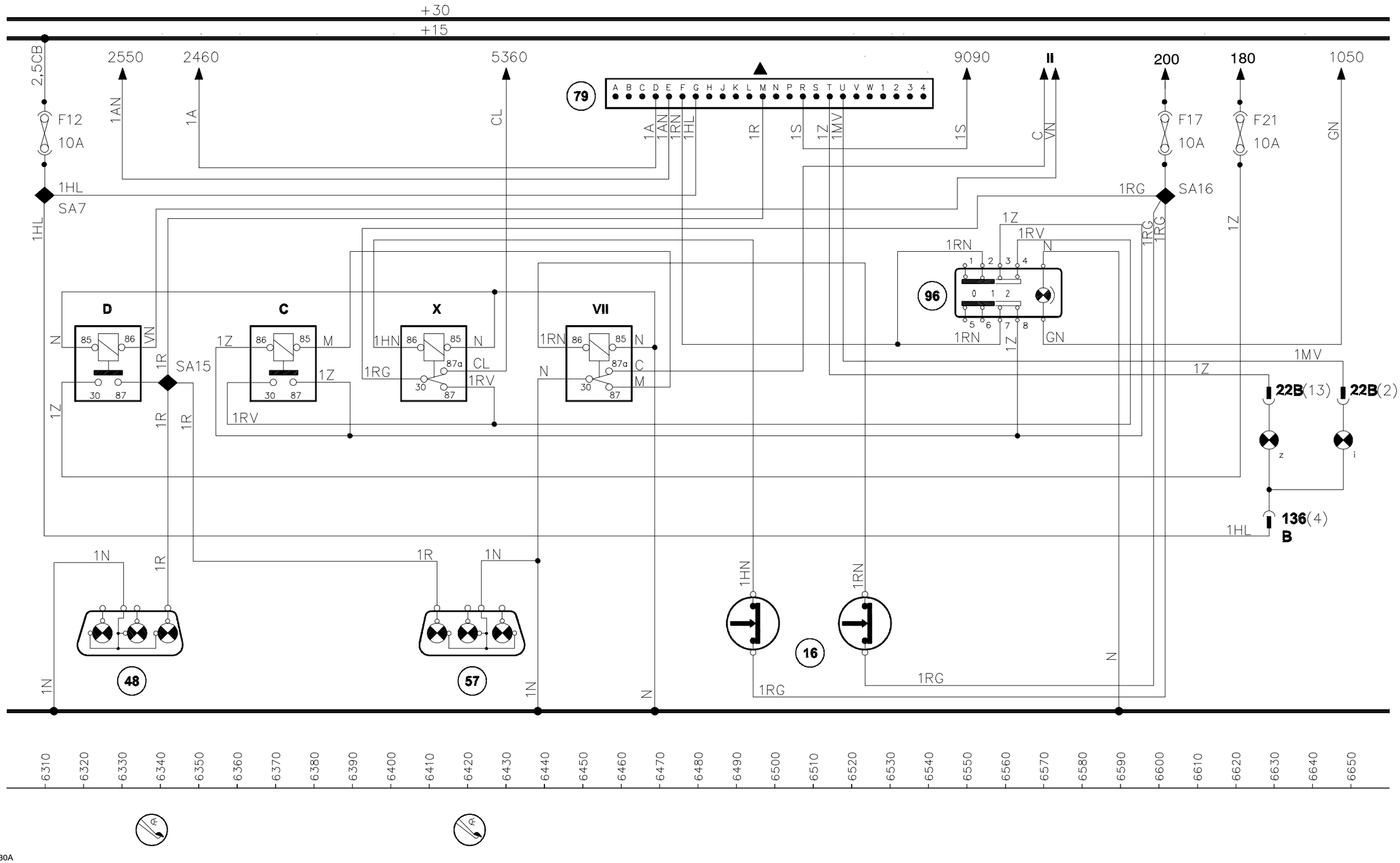
57 LH tail light

79 Transmission side system connection (48 PIN)

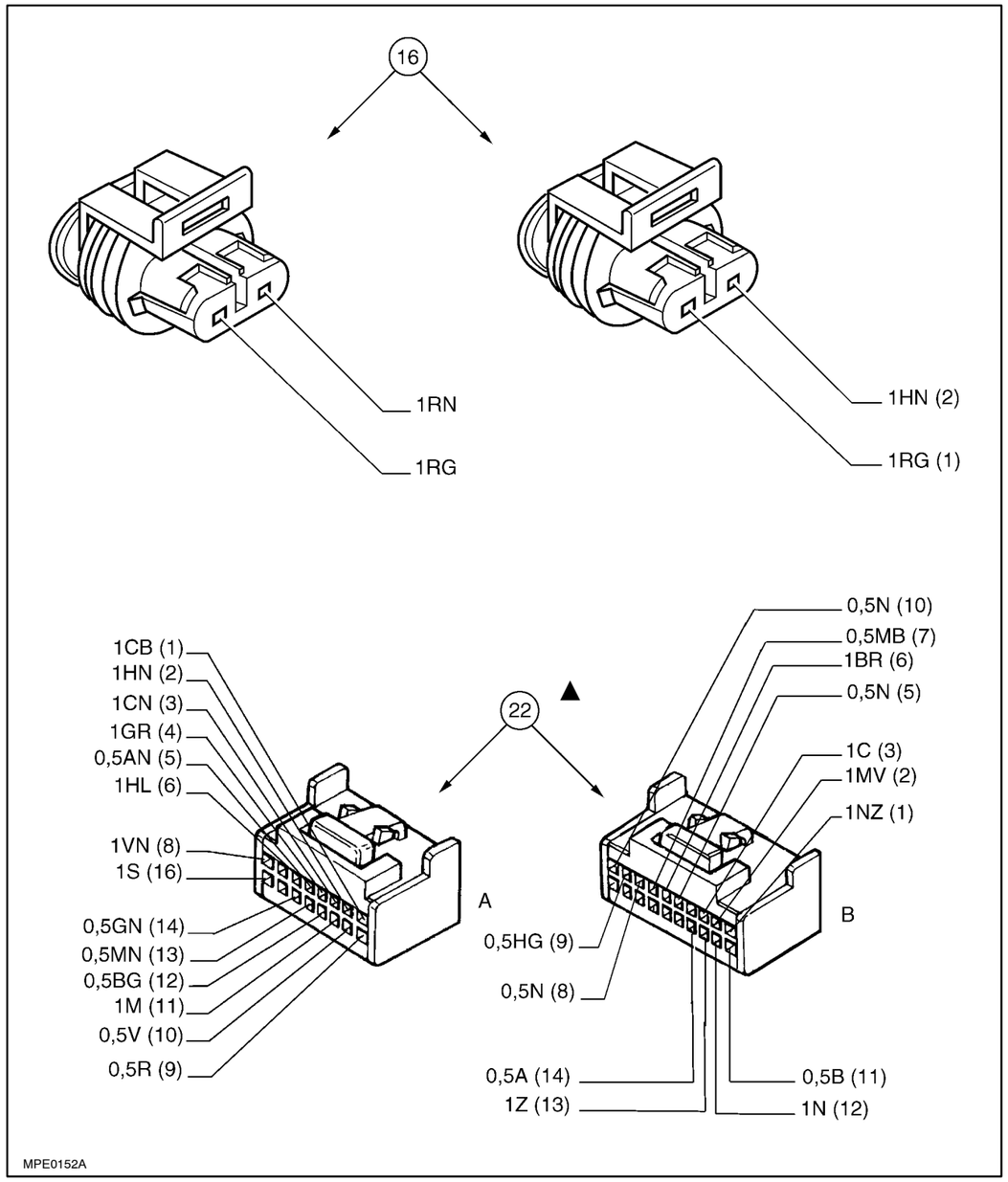
96 Differential lock switch

▲ See diagram O.

DIFFERENTIAL LOCK AND BRAKE LIGHTS CIRCUIT (Version without cab - ISO) - DIAGRAM S

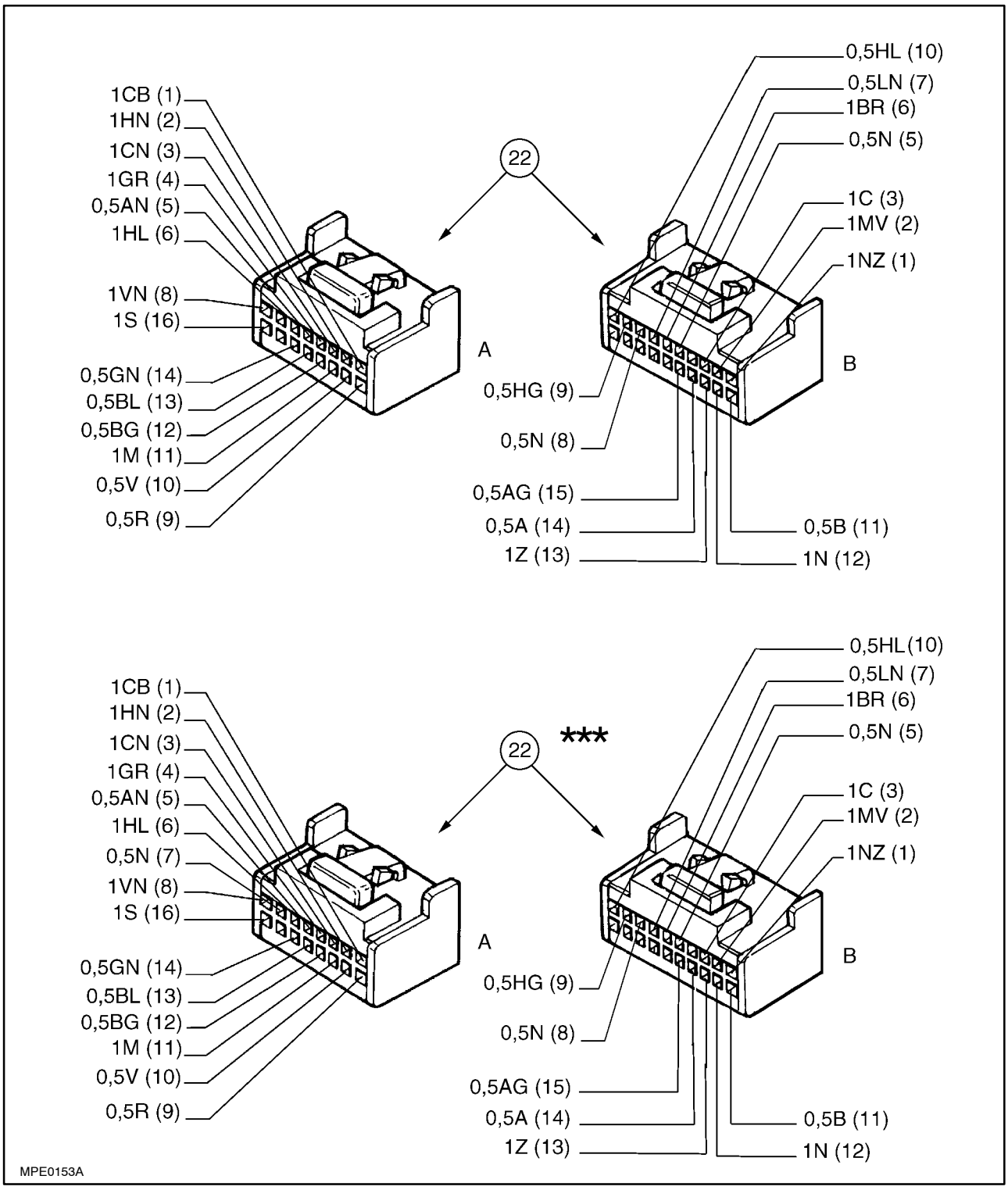


MPD3130A



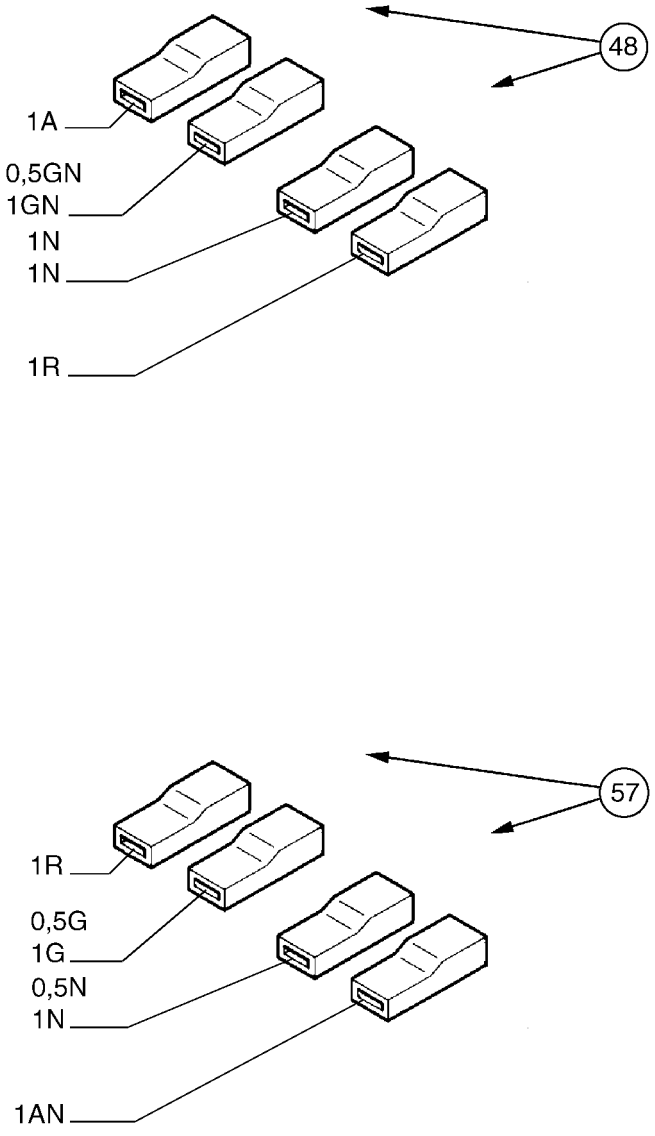
110

▲ Version with Dual Command (2 Speed Power Shift)



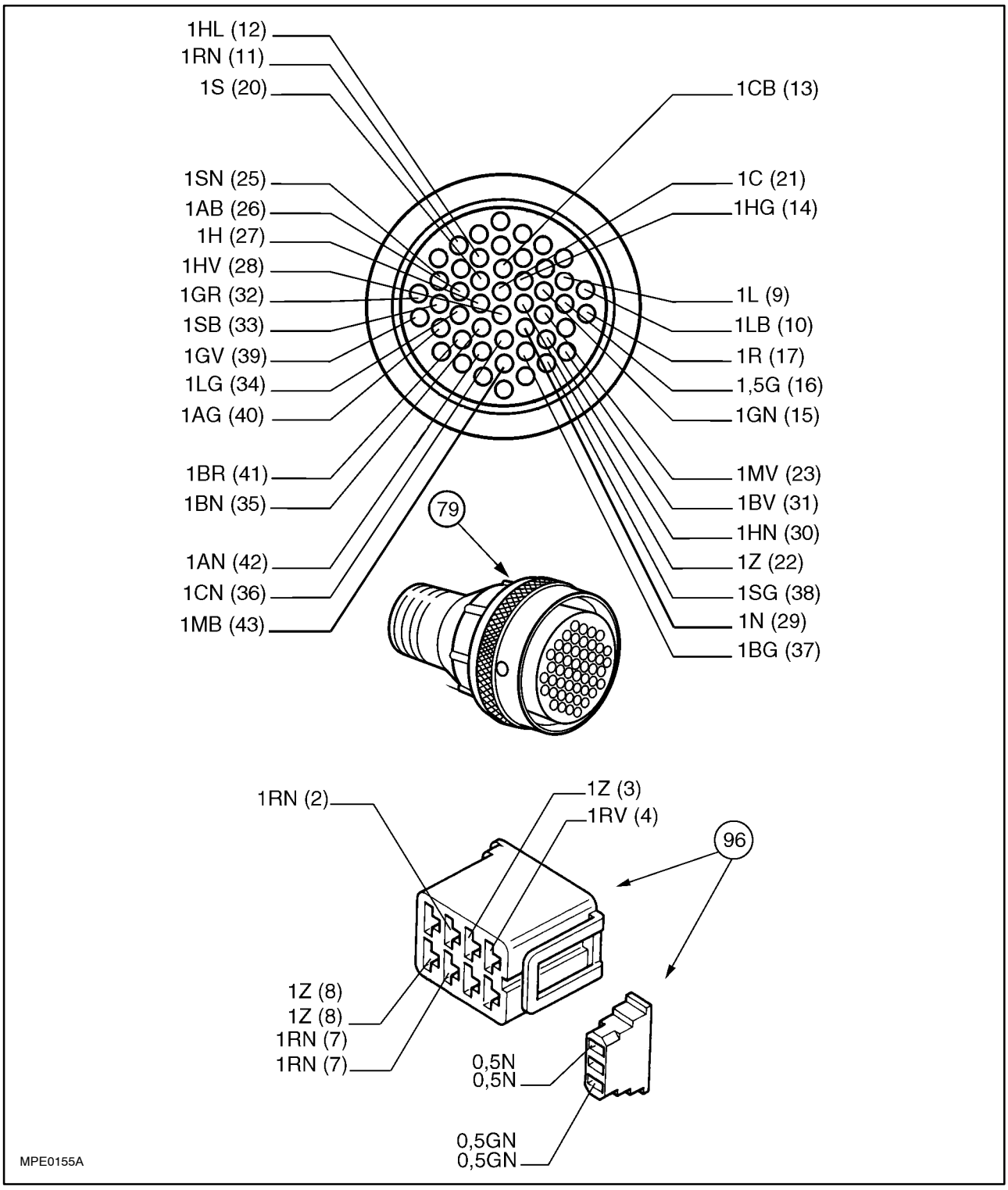
111

*** Power Shuttle version



MPE0154A

112


1HL (12)
1RN (11)
1S (20)
1SN (25)
1AB (26)
1H (27)
1HV (28)
1GR (32)
1SB (33)
1GV (39)
1LG (34)
1AG (40)
1BR (41)
1BN (35)
1AN (42)
1CN (36)
1MB (43)
1CB (13)
1C (21)
1HG (14)
1L (9)
1LB (10)
1R (17)
1,5G (16)
1GN (15)
1MV (23)
1BV (31)
1HN (30)
1Z (22)
1SG (38)
1N (29)
1BG (37)
79
1RN (2)
1Z (3)
1RV (4)
96
1Z (8)
1Z (8)
1RN (7)
1RN (7)
0,5N
0,5N
0,5GN
0,5GN
MPE0155A

113

DIFFERENTIAL LOCK AND BRAKE LIGHTS CIRCUIT
(Version without cab - NASO)
(Diagram T)

15 Fuses and relay control unit
- F12 Instruments, seat safety circuit
- F17 4WD, differential lock circuit
- F21 Brake lights
- C Differential lock circuit
- D Brake lights circuit
- VII Differential lock and brake lights circuit
- X Differential lock circuit

16 Brake lights switches

22 Instrument panel
- i Differential lock
- z Trailer brake ON

79 Transmission side system connection (48 PIN)

96 Differential lock switch

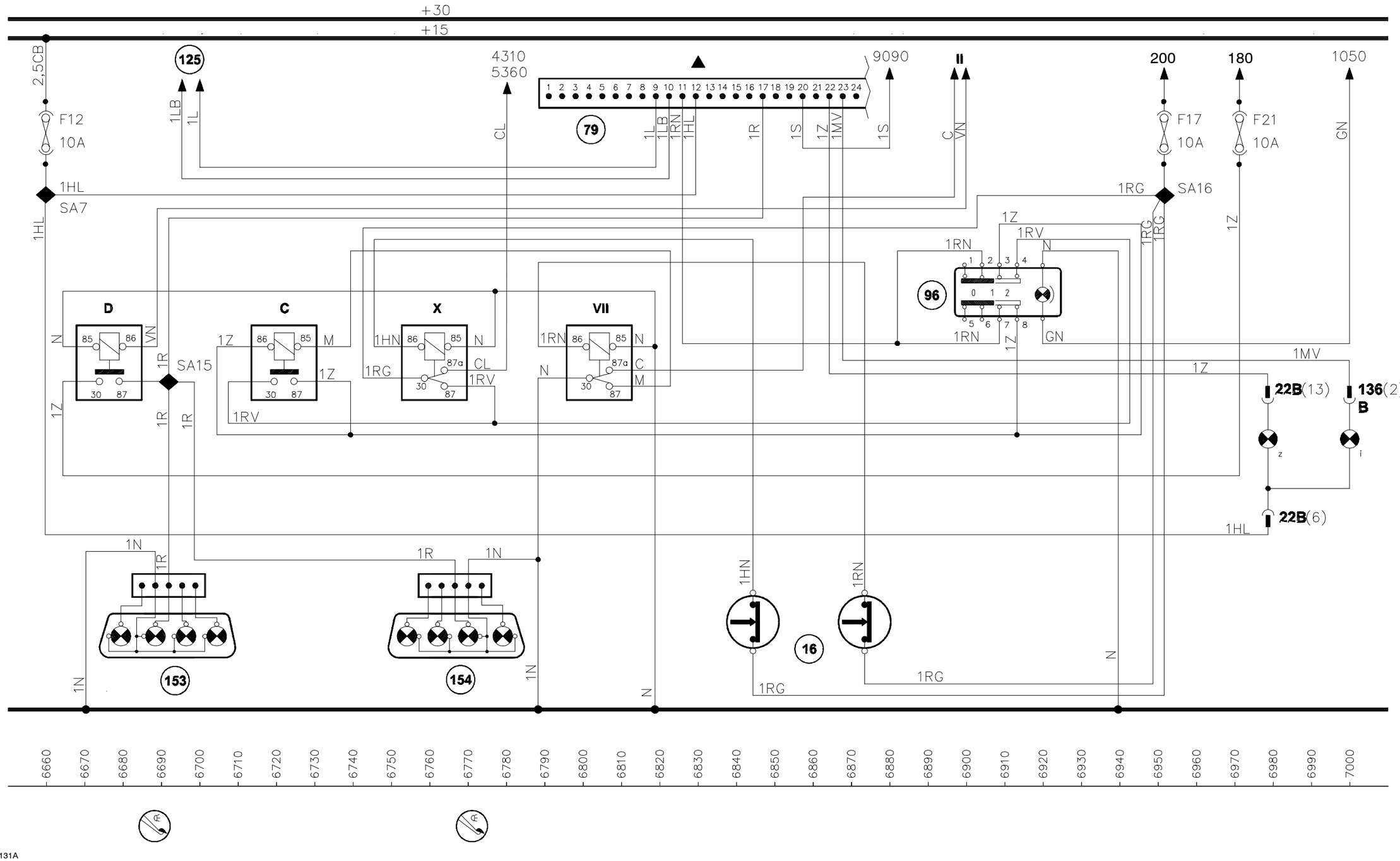
125 Electronic flasher

153 LH two-faced headlight (NASO version)

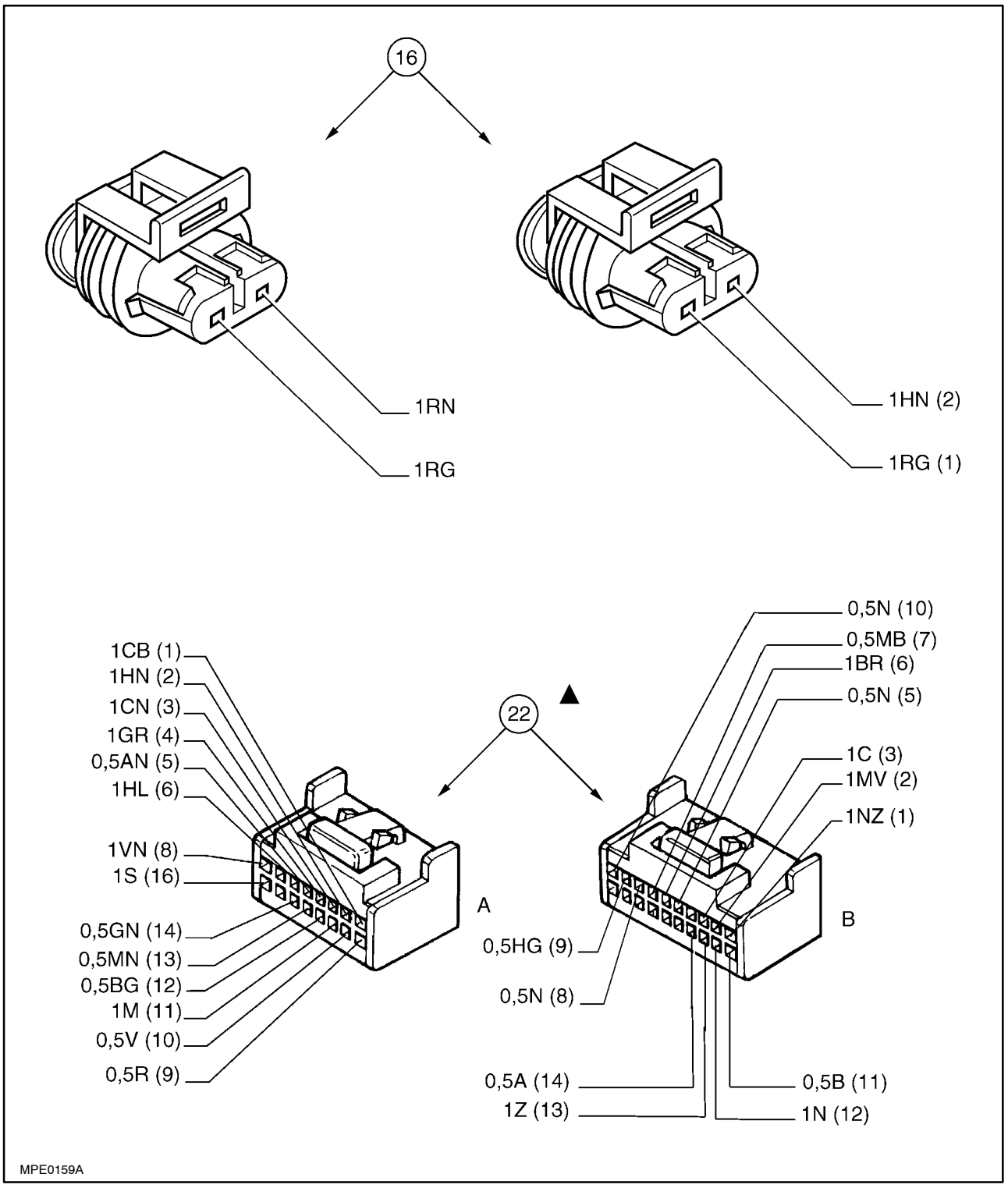
154 RH two-faced headlight (NASO version)

▲ See diagram O.

DIFFERENTIAL LOCK AND BRAKE LIGHTS CIRCUIT (Version without cab - NASO) - DIAGRAM T

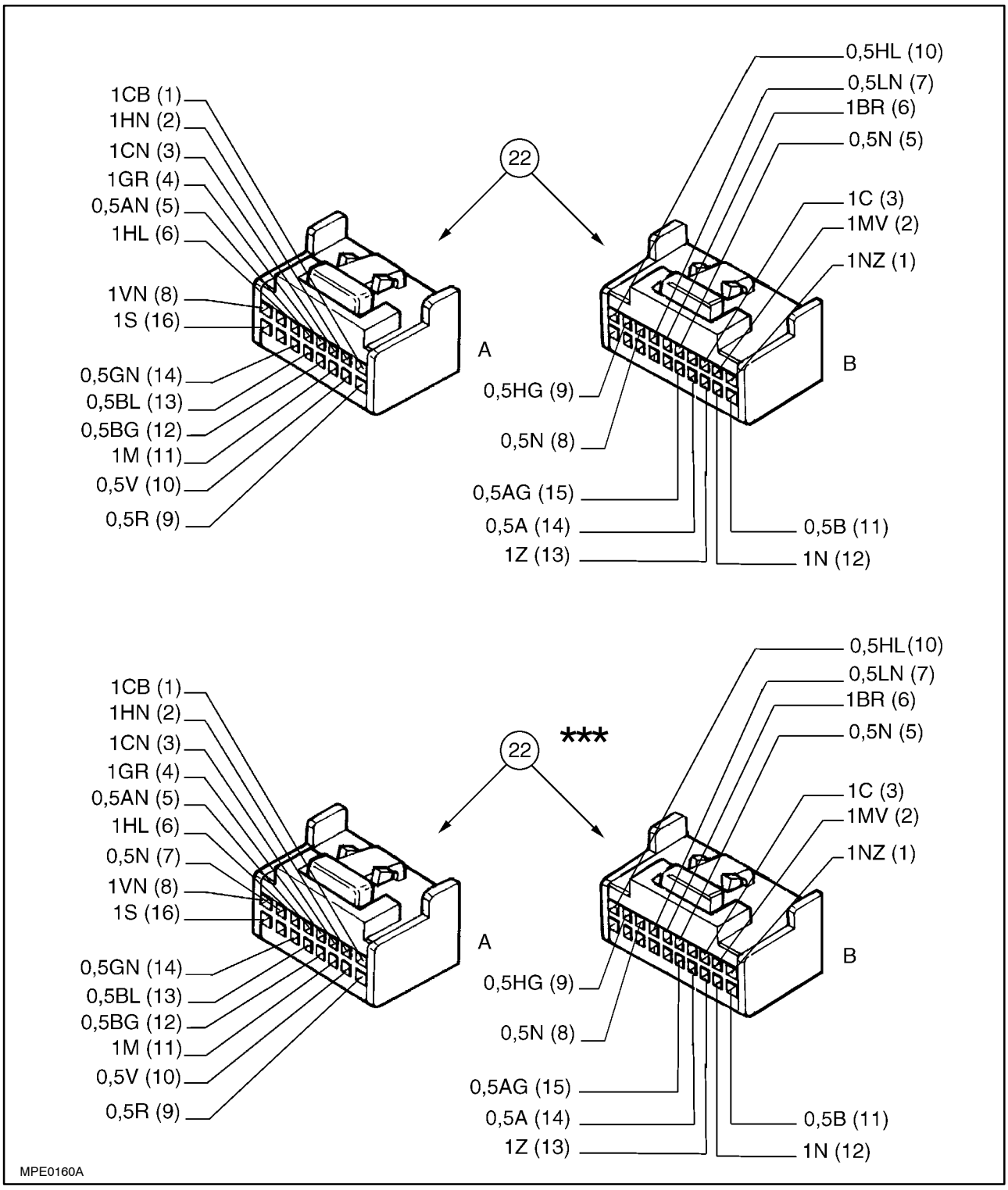


MPD3131A



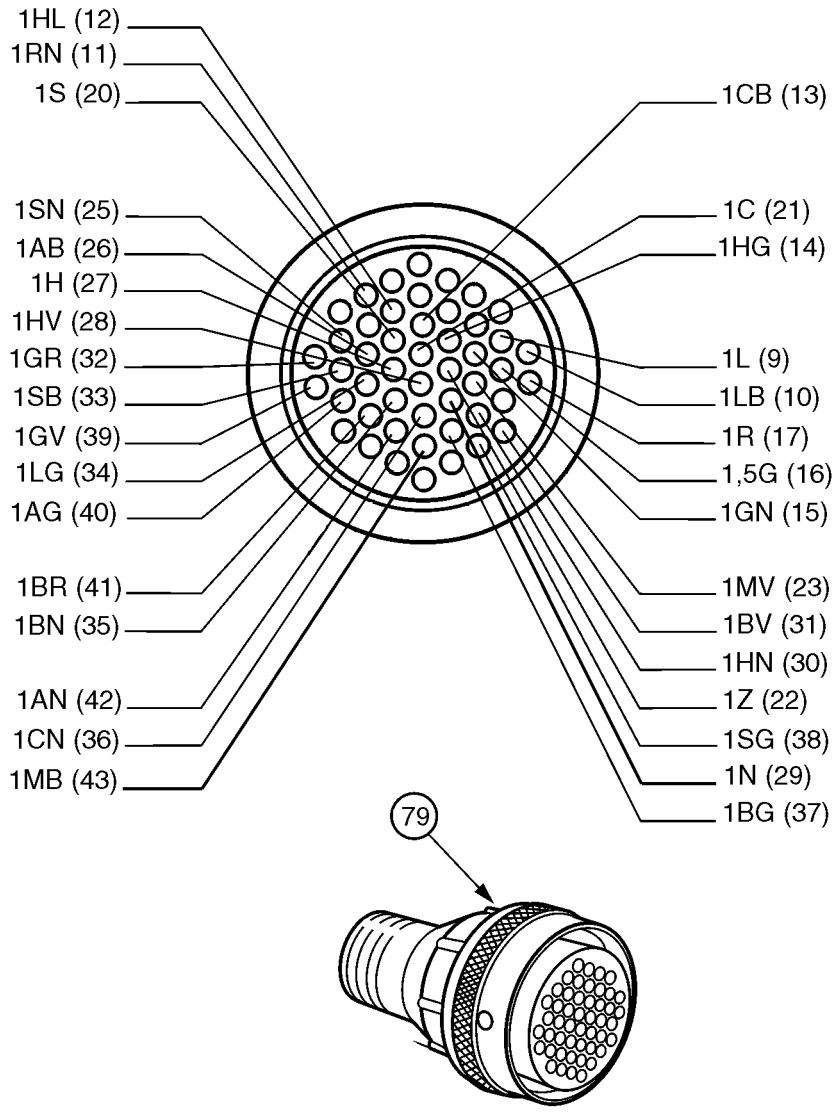
114

▲ Version with Dual Command (2 Speed Power Shift)

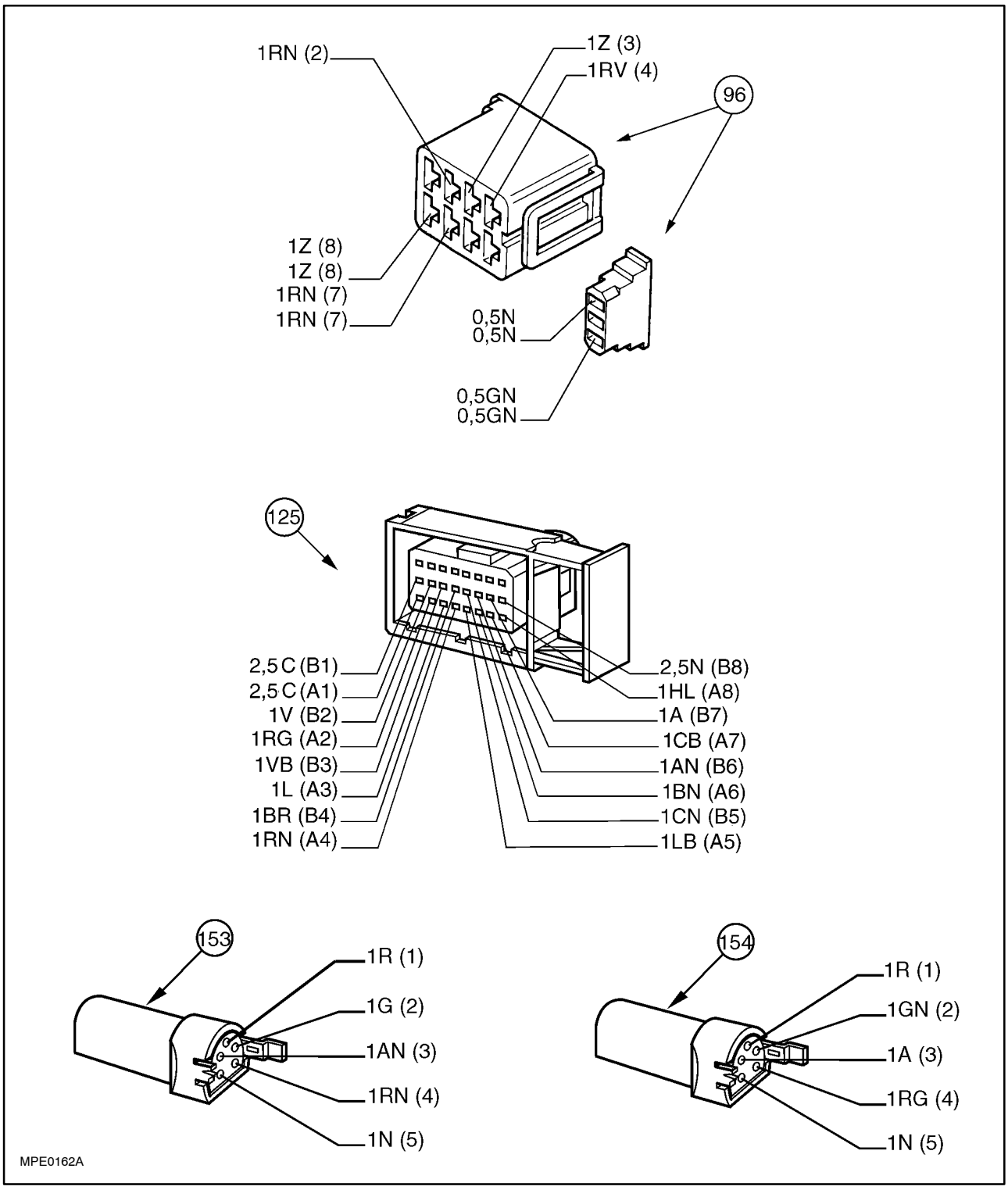


115

*** Power Shuttle version

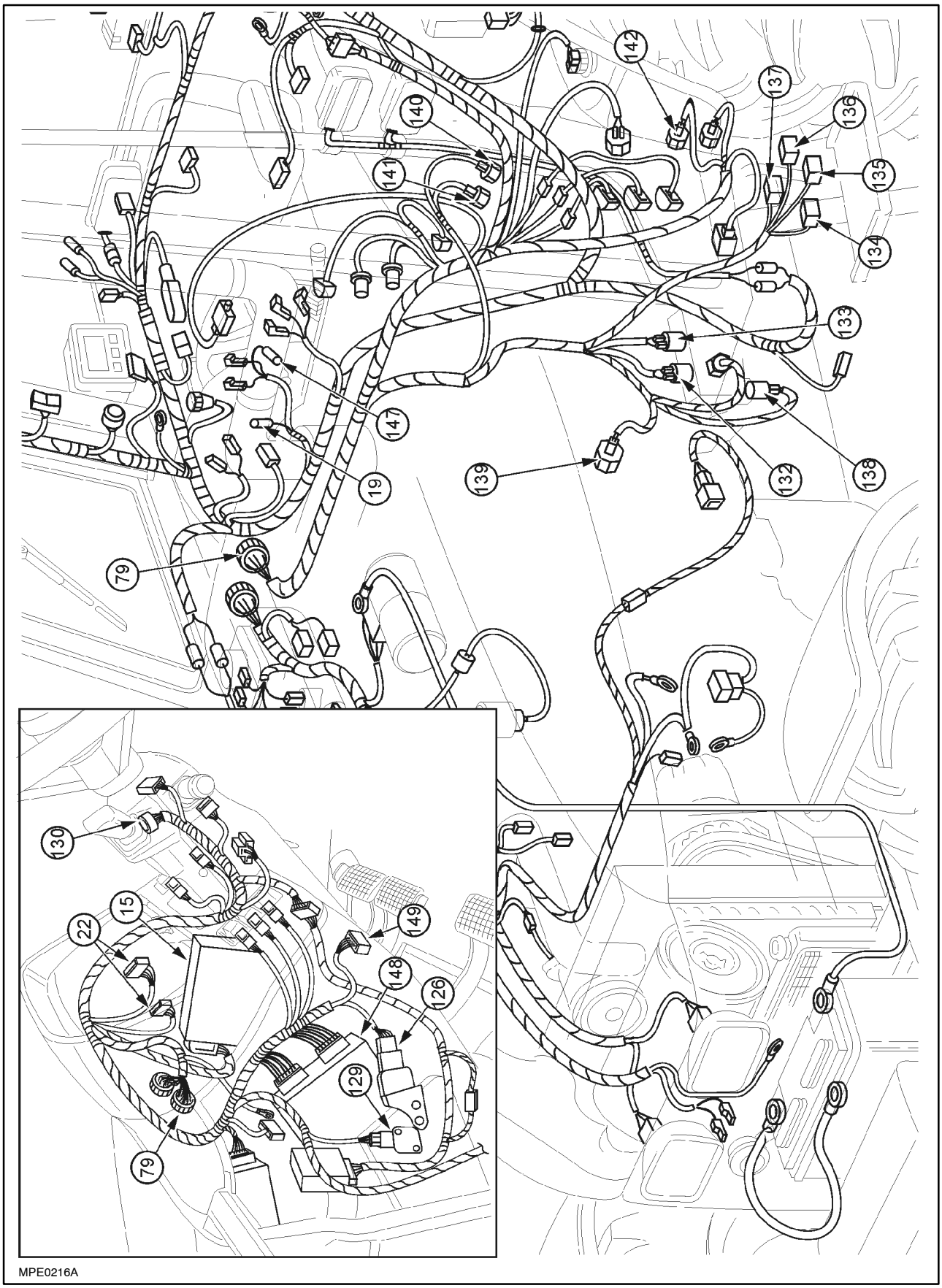

1HL (12)
1RN (11)
1S (20)
1SN (25)
1AB (26)
1H (27)
1HV (28)
1GR (32)
1SB (33)
1GV (39)
1LG (34)
1AG (40)
1BR (41)
1BN (35)
1AN (42)
1CN (36)
1MB (43)
1CB (13)
1C (21)
1HG (14)
1L (9)
1LB (10)
1R (17)
1,5G (16)
1GN (15)
1MV (23)
1BV (31)
1HN (30)
1Z (22)
1SG (38)
1N (29)
1BG (37)
79
MPE0161A

116


1RN (2)
1Z (3)
1RV (4)
96
1Z (8)
1Z (8)
1RN (7)
1RN (7)
0,5N
0,5N
0,5GN
0,5GN
125
2,5 C (B1)
2,5 C (A1)
1V (B2)
1RG (A2)
1VB (B3)
1L (A3)
1BR (B4)
1RN (A4)
2,5N (B8)
1HL (A8)
1A (B7)
1CB (A7)
1AN (B6)
1BN (A6)
1CN (B5)
1LB (A5)
153
1R (1)
1G (2)
1AN (3)
1RN (4)
1N (5)
154
1R (1)
1GN (2)
1A (3)
1RG (4)
1N (5)
MPE0162A

117

WIRING DIAGRAMS U/1 - U/2



MPE0216A

POWER SHUTTLE CIRCUIT
(Diagram U/1)

15 Fuses and relay control unit
- F1 Power Shuttle circuit
- F2 Power Shuttle circuit
- F9 Electronic lift circuit and Power Shuttle (+ Battery)
- F12 Trailer brake circuit, instruments, seat safety circuit
- F23 Safety and starting circuit

19 Dual Command (2 Speed Power Shift) control switch

22 Instrument panel
- f High gear range ON
- g Low gear range ON
- u Power Shuttle alarm

79 Transmission side system connection (48 PIN)

93 Ignition switch

126 Clutch pedal switch

129 Clutch pedal sensor

130 Power Shuttle control lever

147 Handbrake status switch

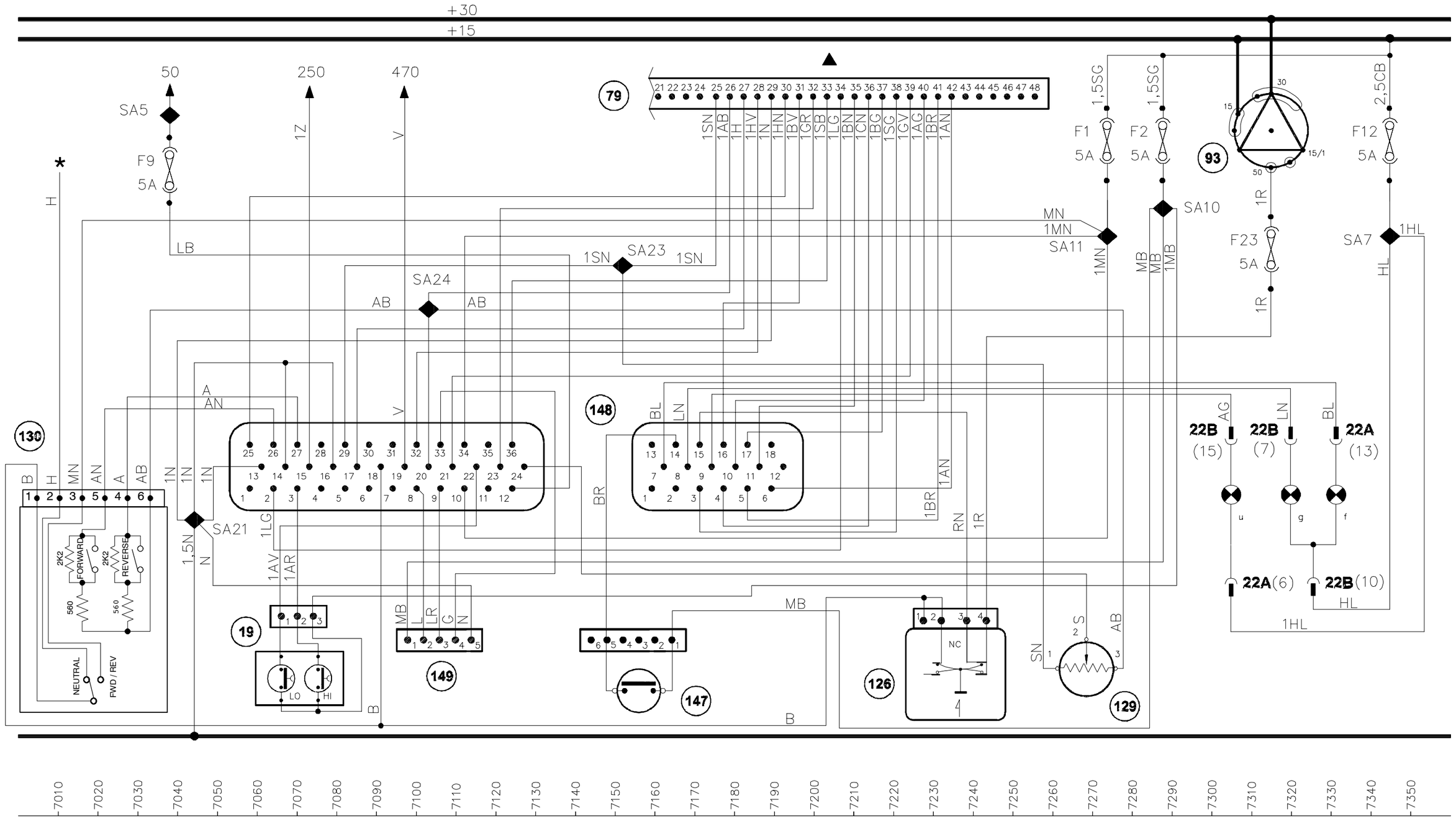
148 Power Shuttle control unit

149 Power Shuttle circuit diagnosis connection

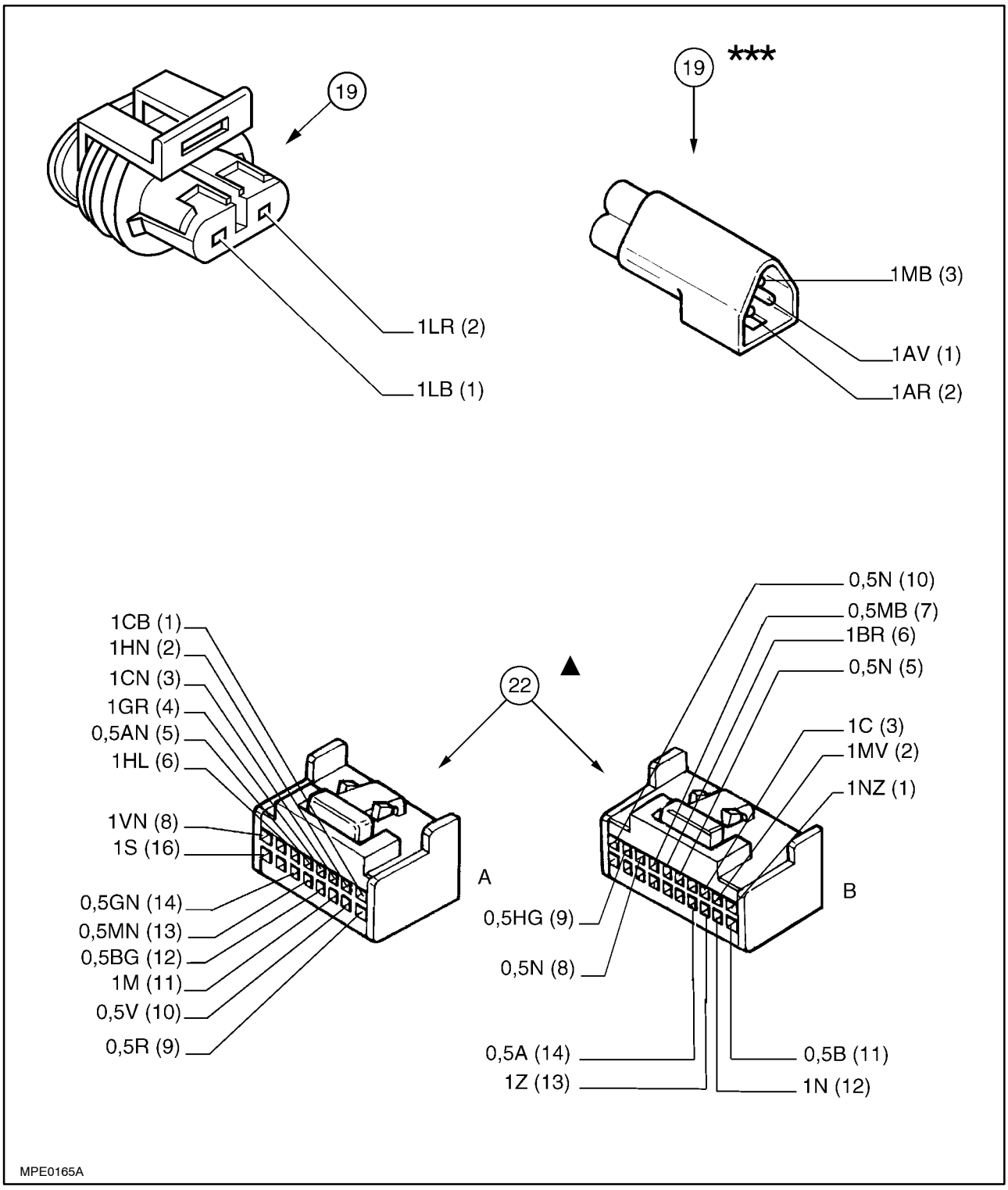
▲ See Diagram U/2.

✱ See diagram A.

POWER SHUTTLE CIRCUIT - DIAGRAM U/1



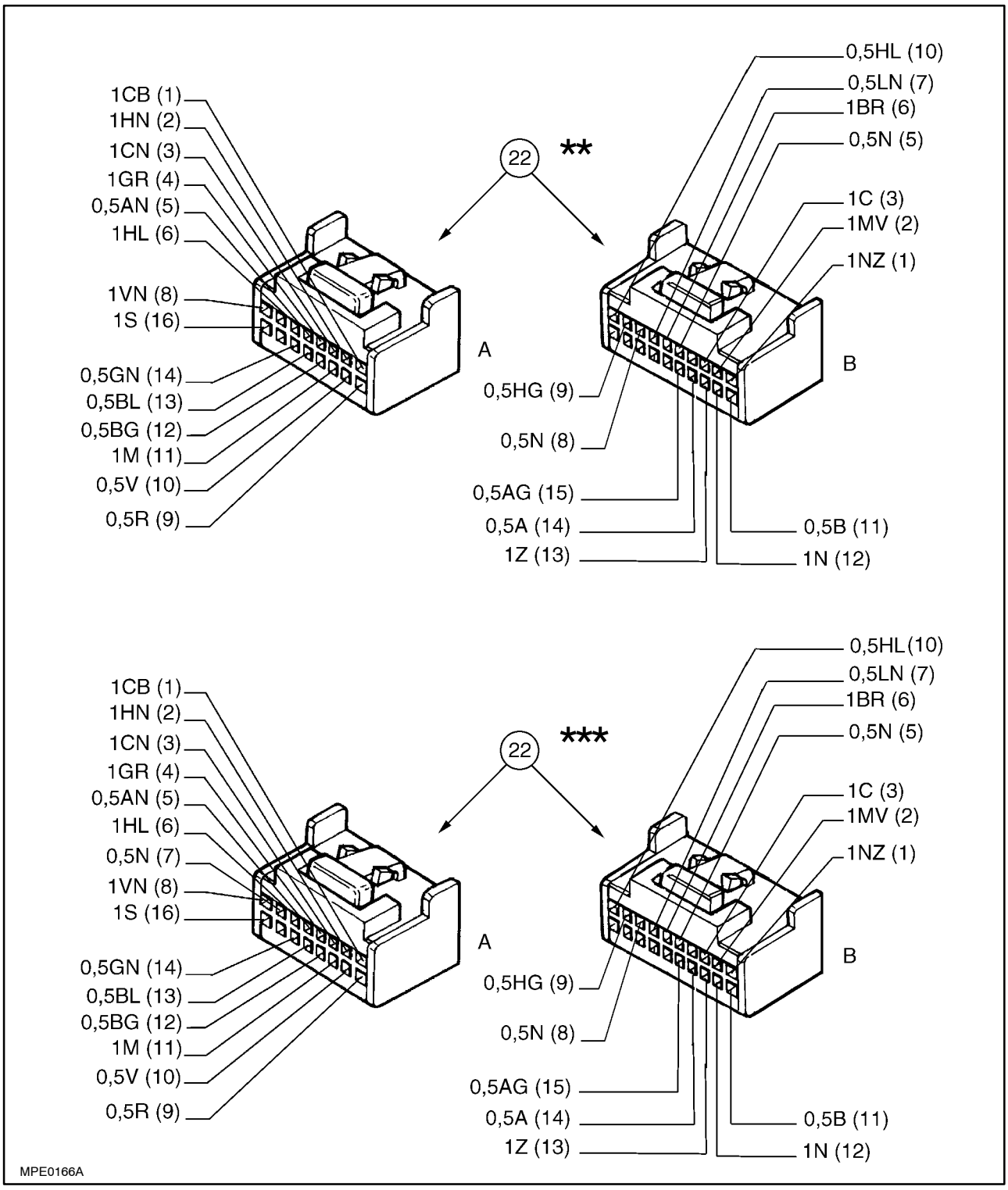
MPD3132A



119

*** Power Shuttle version

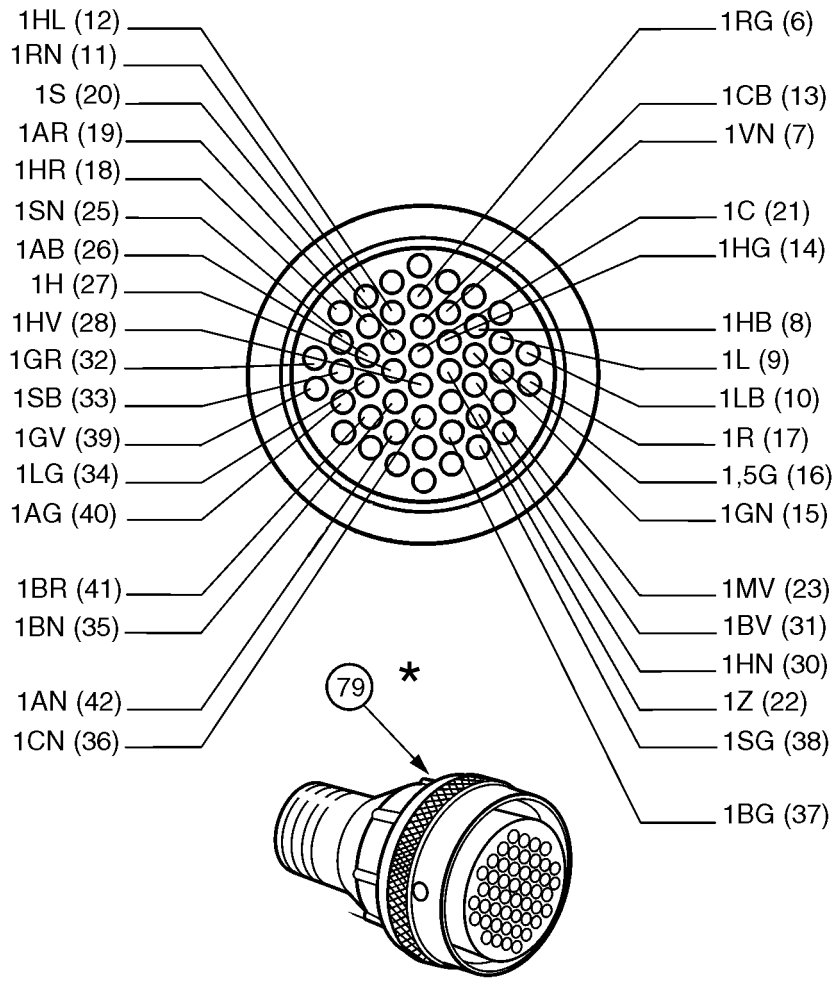
▲ Version with Dual Command (2 Speed Power Shift)



120

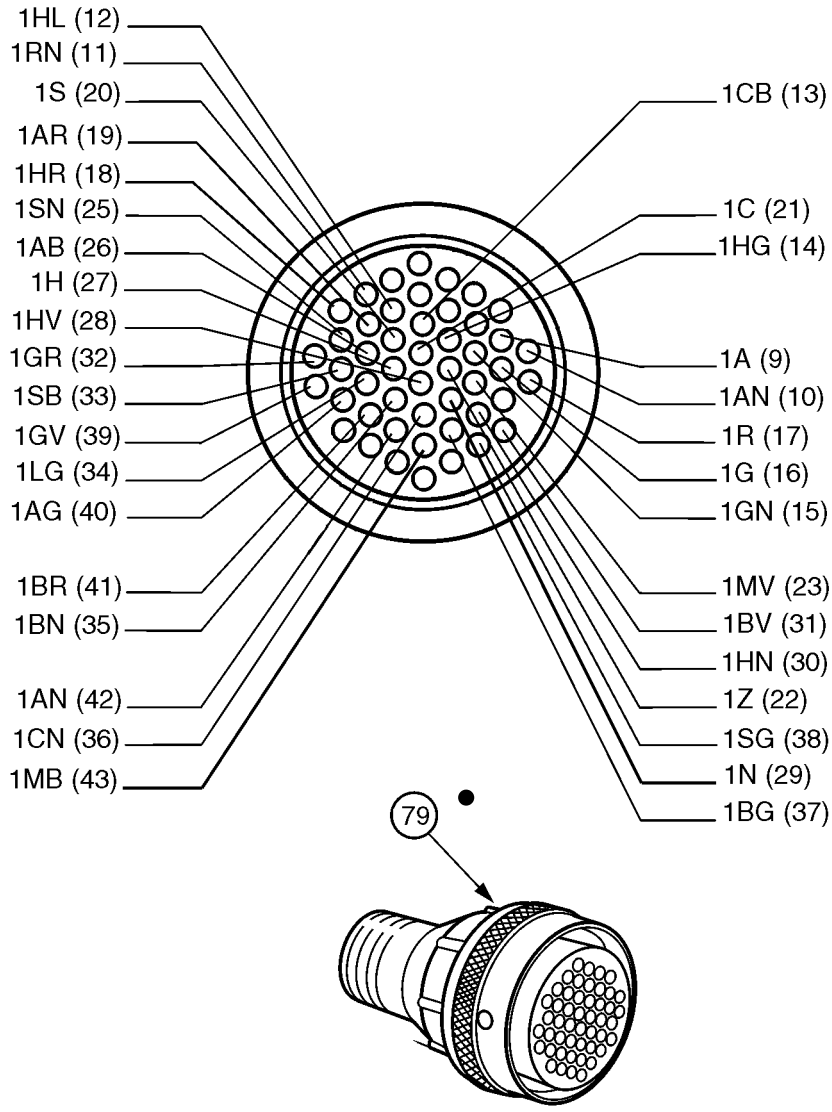
** Version without cab

*** Power Shuttle version



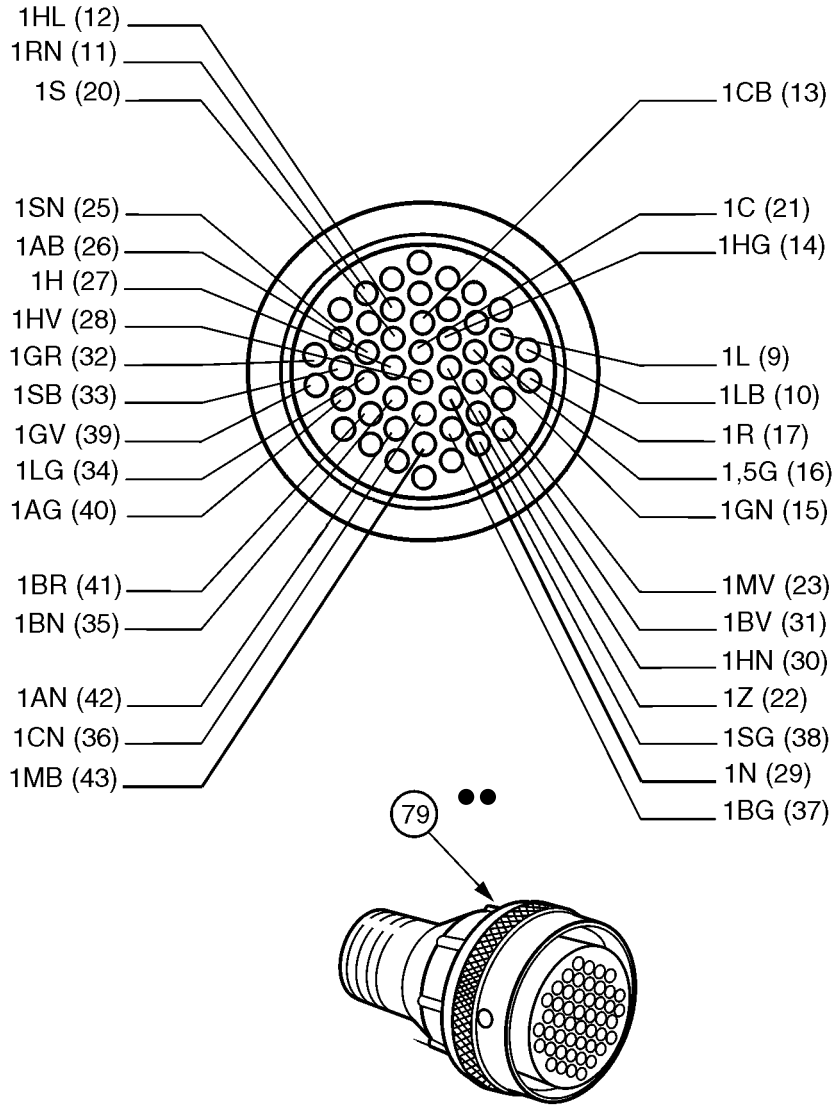
121

* Version with cab



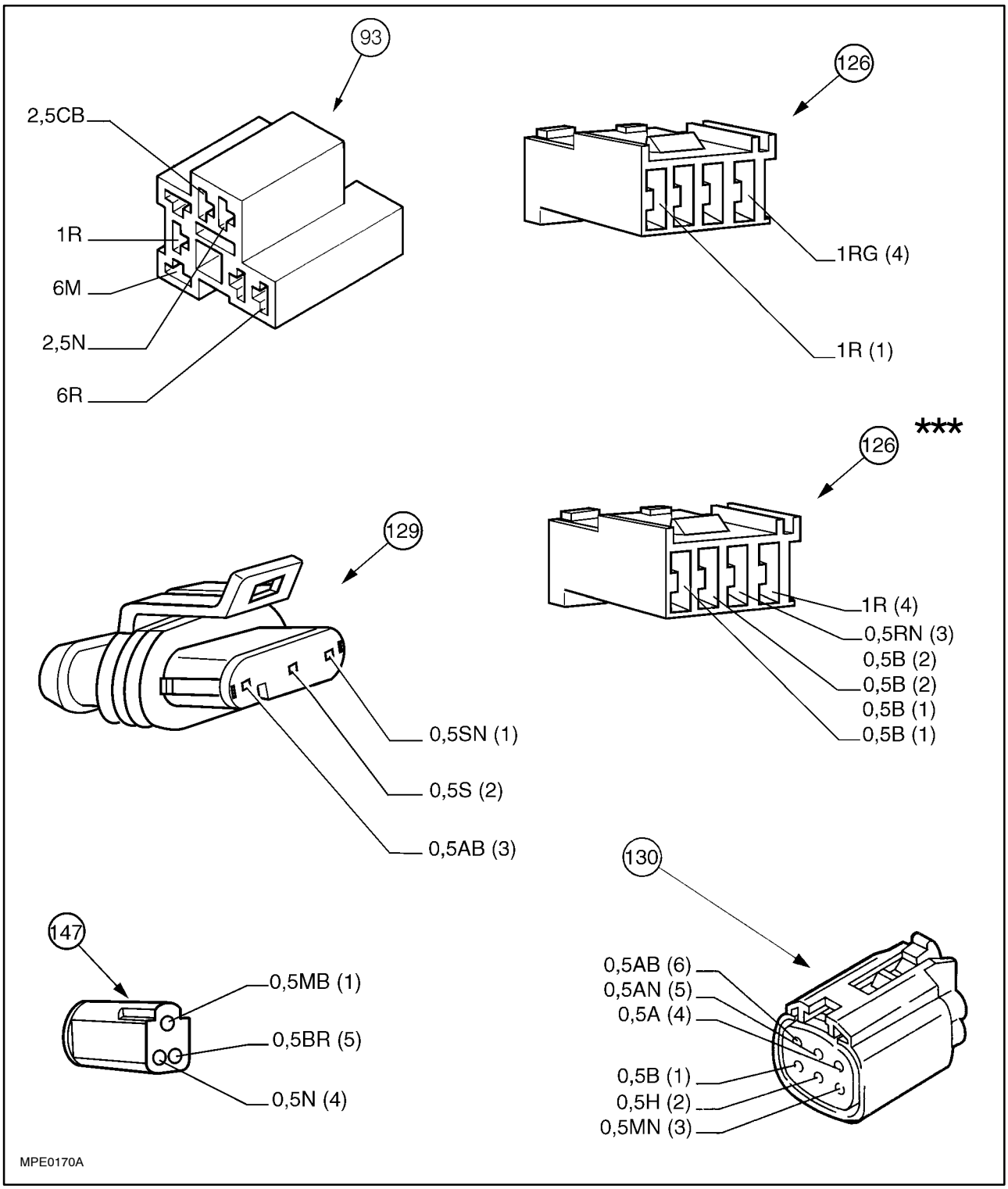
122

- Version without cab (ISO)



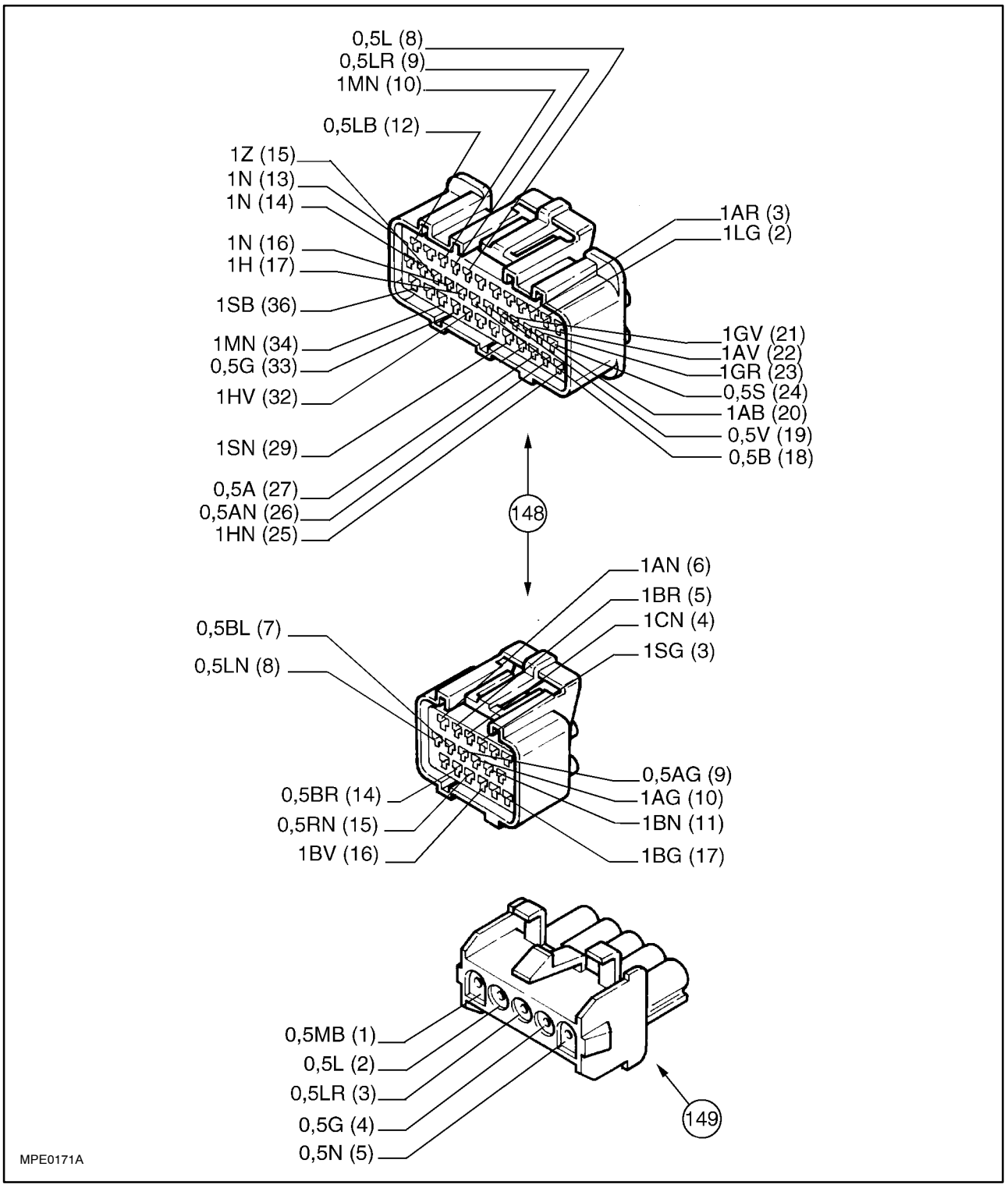
123

●● Version without cab (NASO)



124

*** Power Shuttle version


0,5L (8)
0,5LR (9)
1MN (10)
0,5LB (12)
1Z (15)
1N (13)
1N (14)
1N (16)
1H (17)
1SB (36)
1MN (34)
0,5G (33)
1HV (32)
1SN (29)
0,5A (27)
0,5AN (26)
1HN (25)
1AR (3)
1LG (2)
1GV (21)
1AV (22)
1GR (23)
0,5S (24)
1AB (20)
0,5V (19)
0,5B (18)
148
1AN (6)
1BR (5)
1CN (4)
1SG (3)
0,5BL (7)
0,5LN (8)
0,5AG (9)
1AG (10)
1BN (11)
1BG (17)
0,5BR (14)
0,5RN (15)
1BV (16)
0,5MB (1)
0,5L (2)
0,5LR (3)
0,5G (4)
0,5N (5)
149
MPE0171A

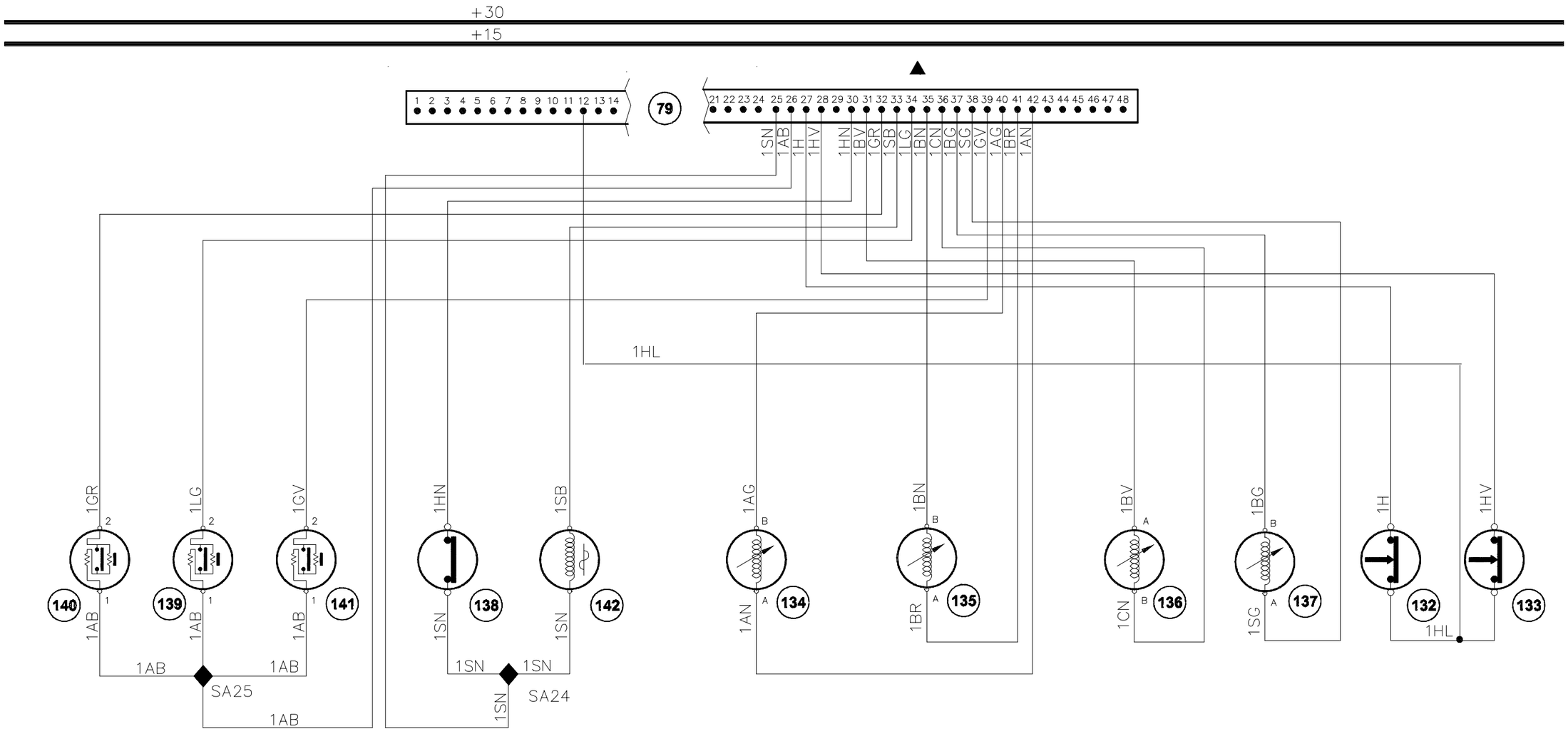
125

POWER SHUTTLE CIRCUIT
(Diagram U/2)

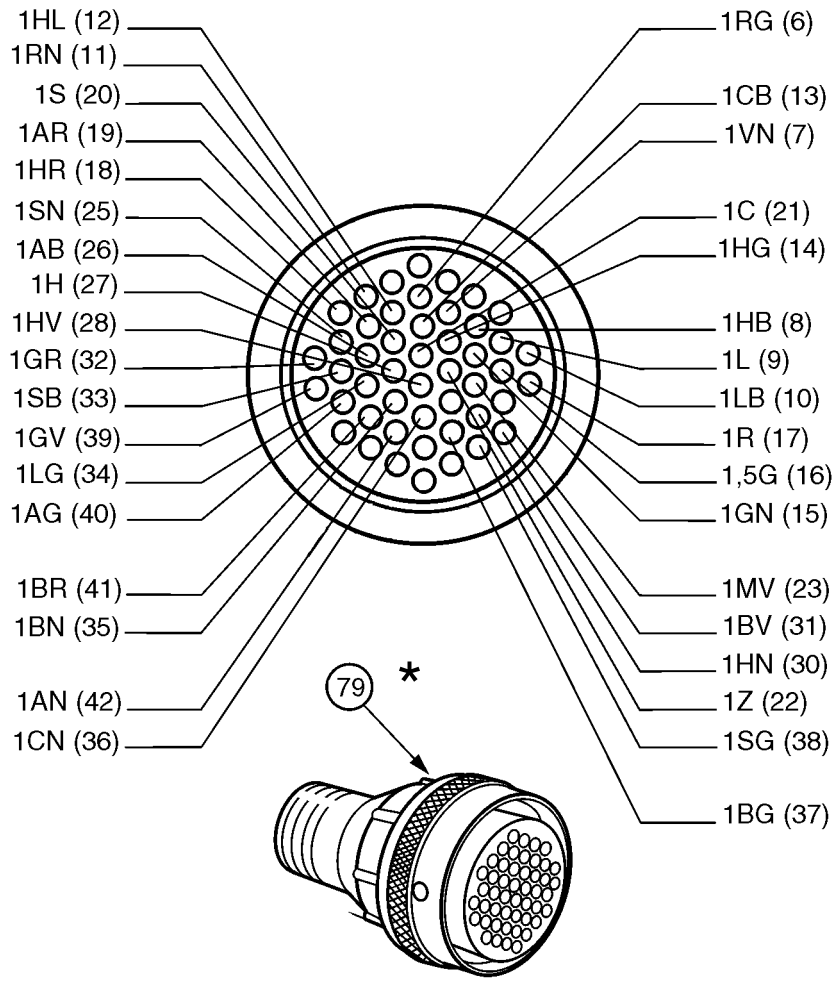
79 Transmission side system connection (48 PIN)
132 Safety pressure switch A
133 Safety pressure switch B
134 Clutch A solenoid valve
135 Clutch B solenoid valve
136 Clutch C solenoid valve
137 Clutch D solenoid valve
138 Transmission oil temperature sensor
139 Gear lever position sensor
140 R1 range lever position sensor
141 R2 range lever position sensor
142 Power Shuttle control unit speed sensor

▲ See diagram U/1.

POWER SHUTTLE CIRCUIT - DIAGRAM U/2

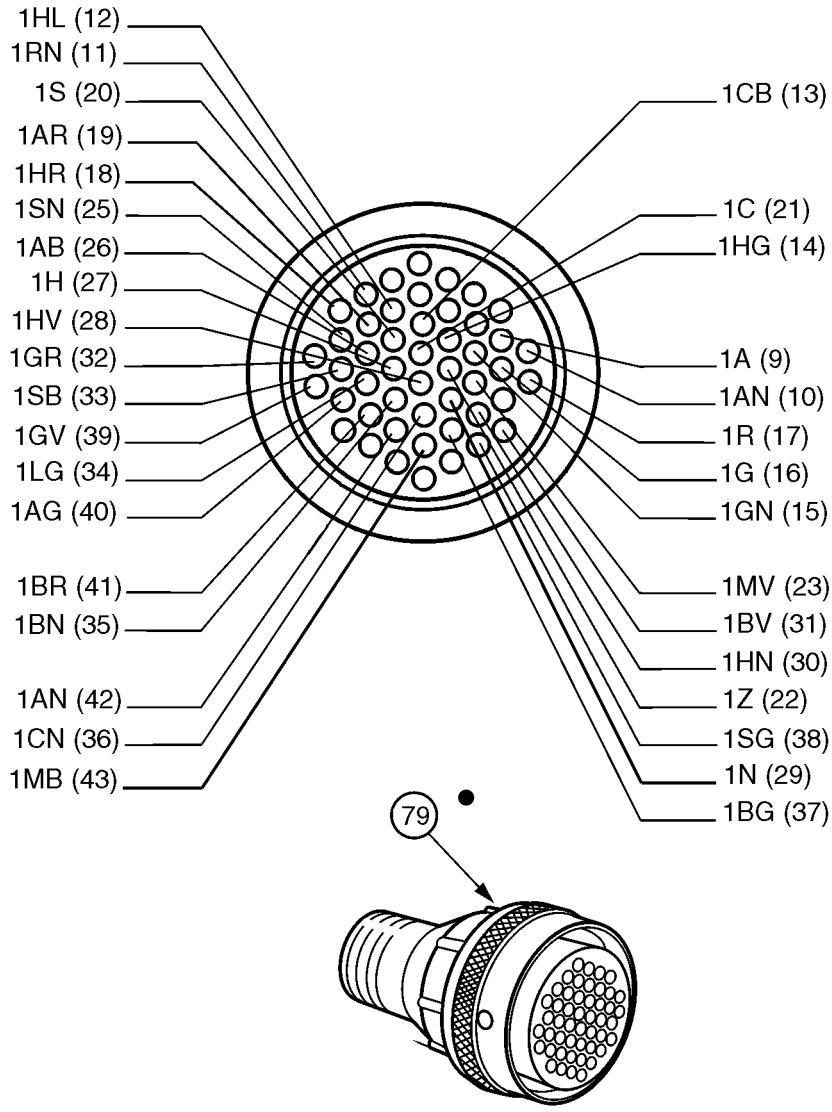


MPD3133A



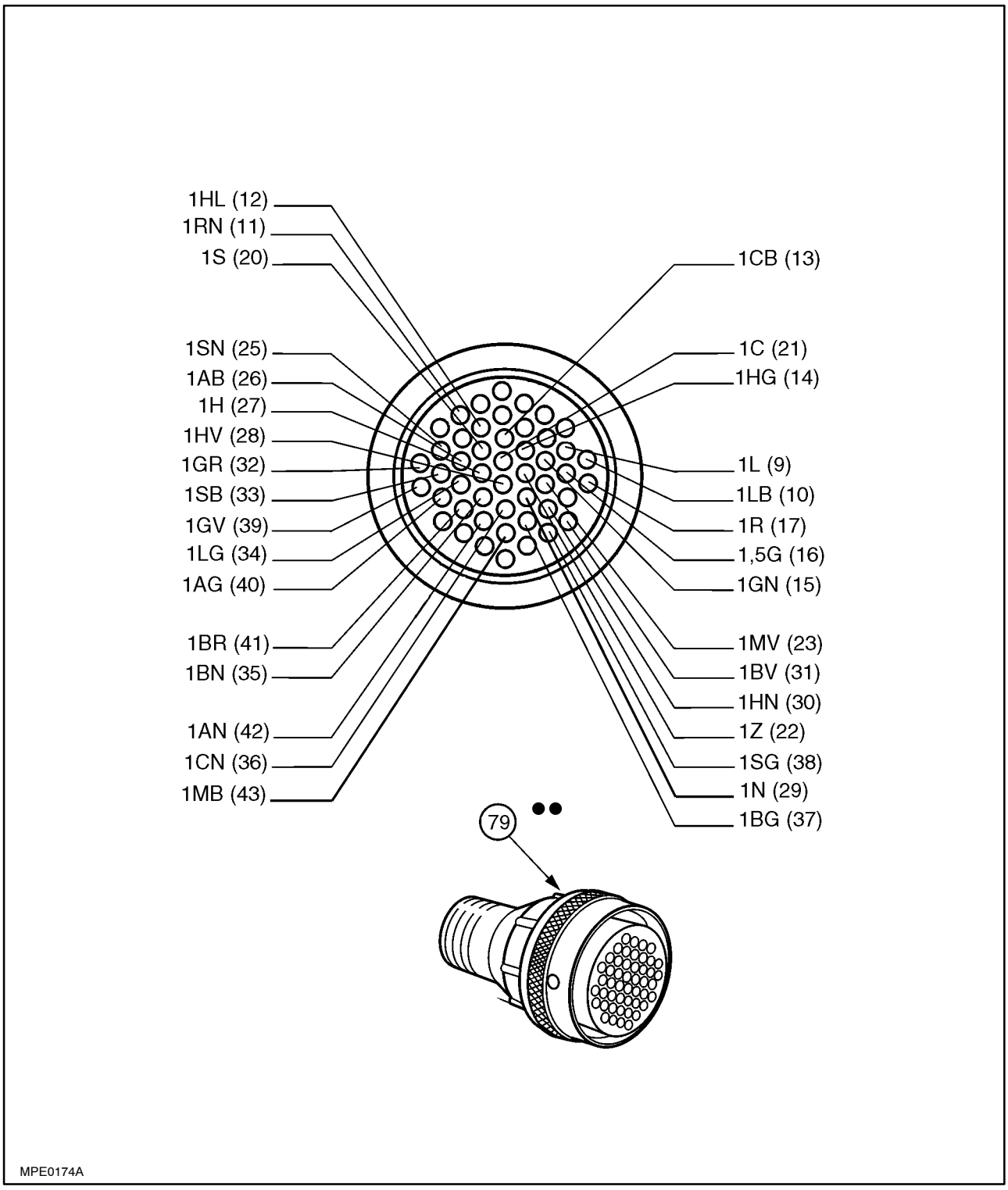
126

* Version with cab



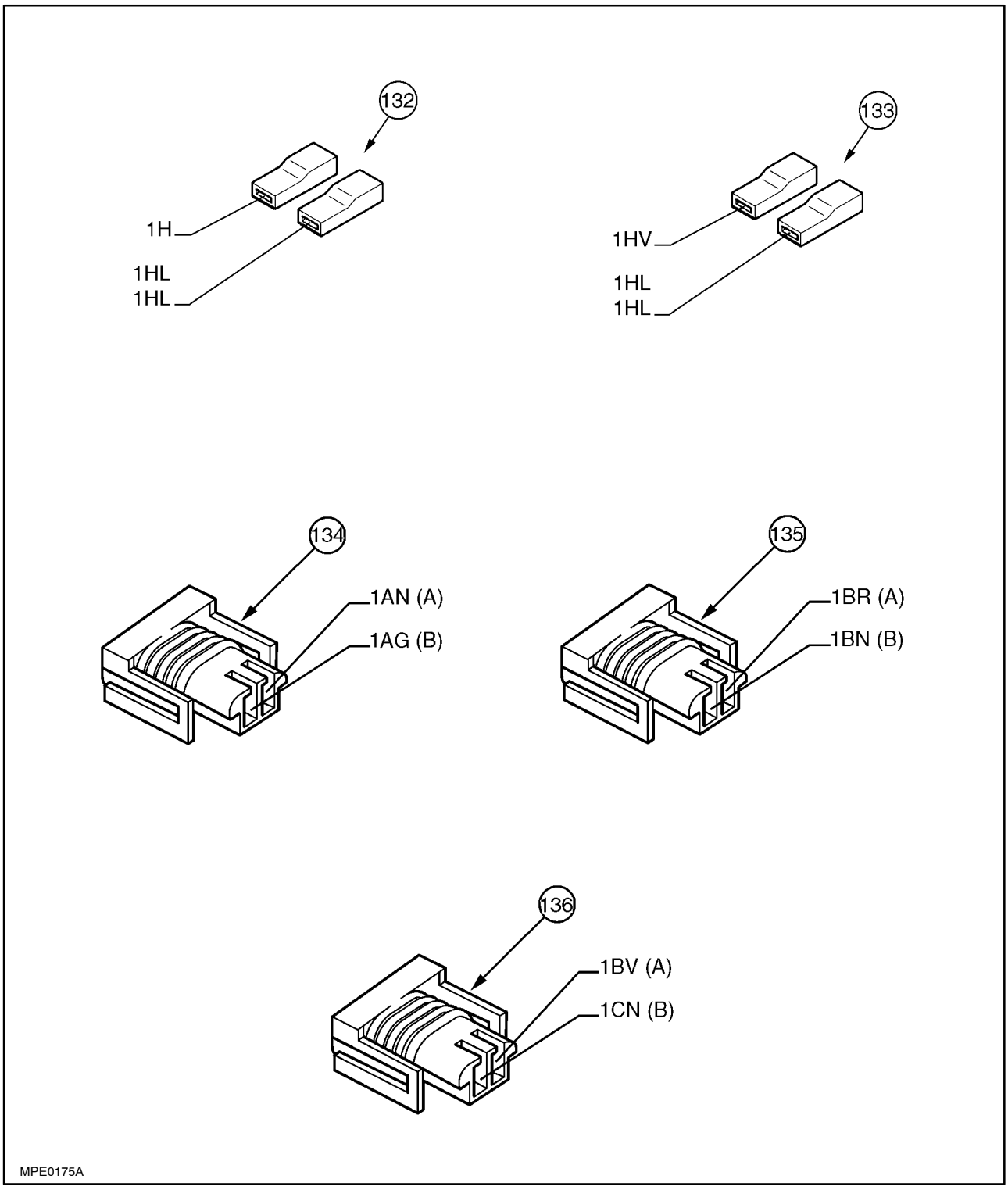
127

- Version without cab (ISO)

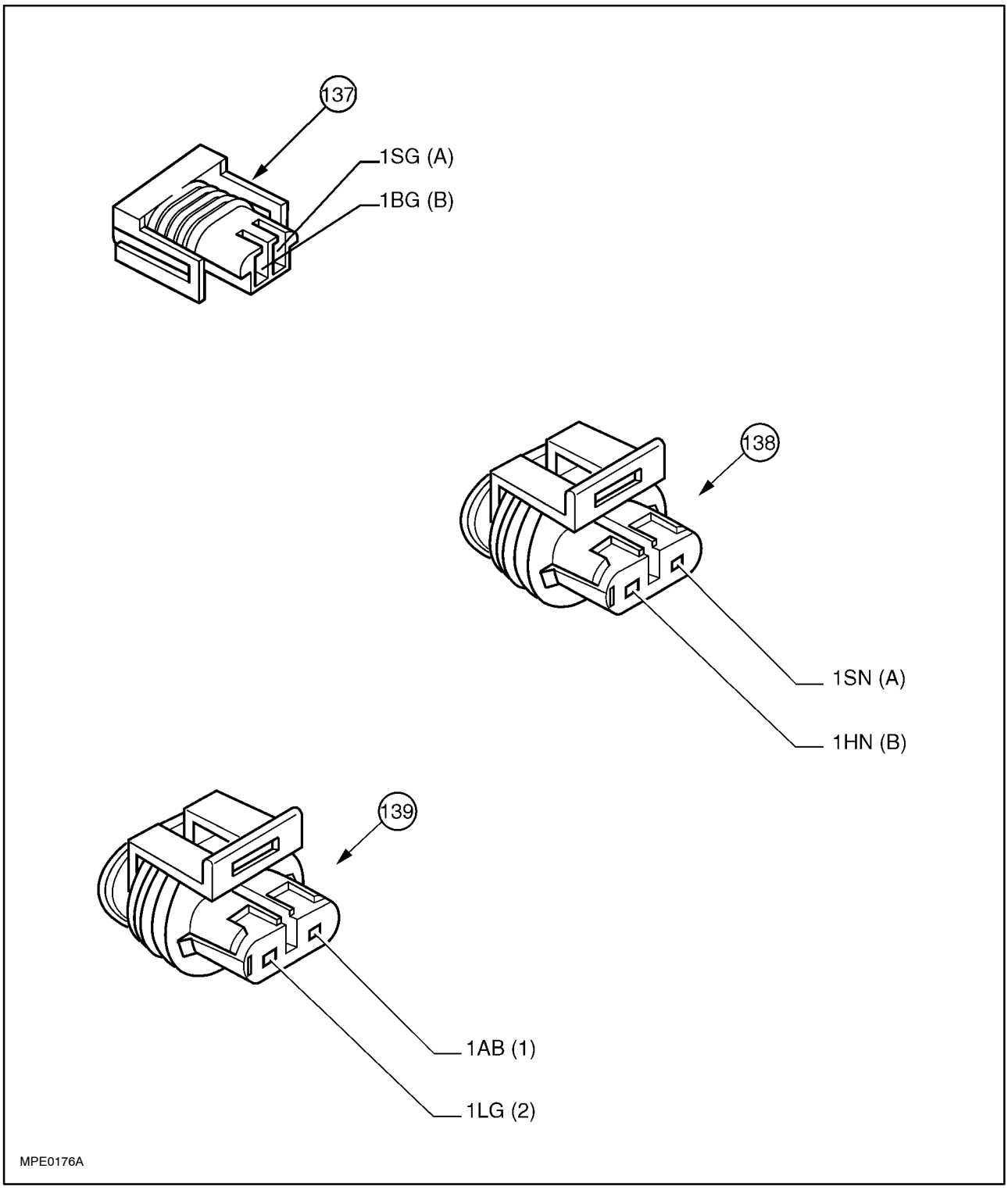


128

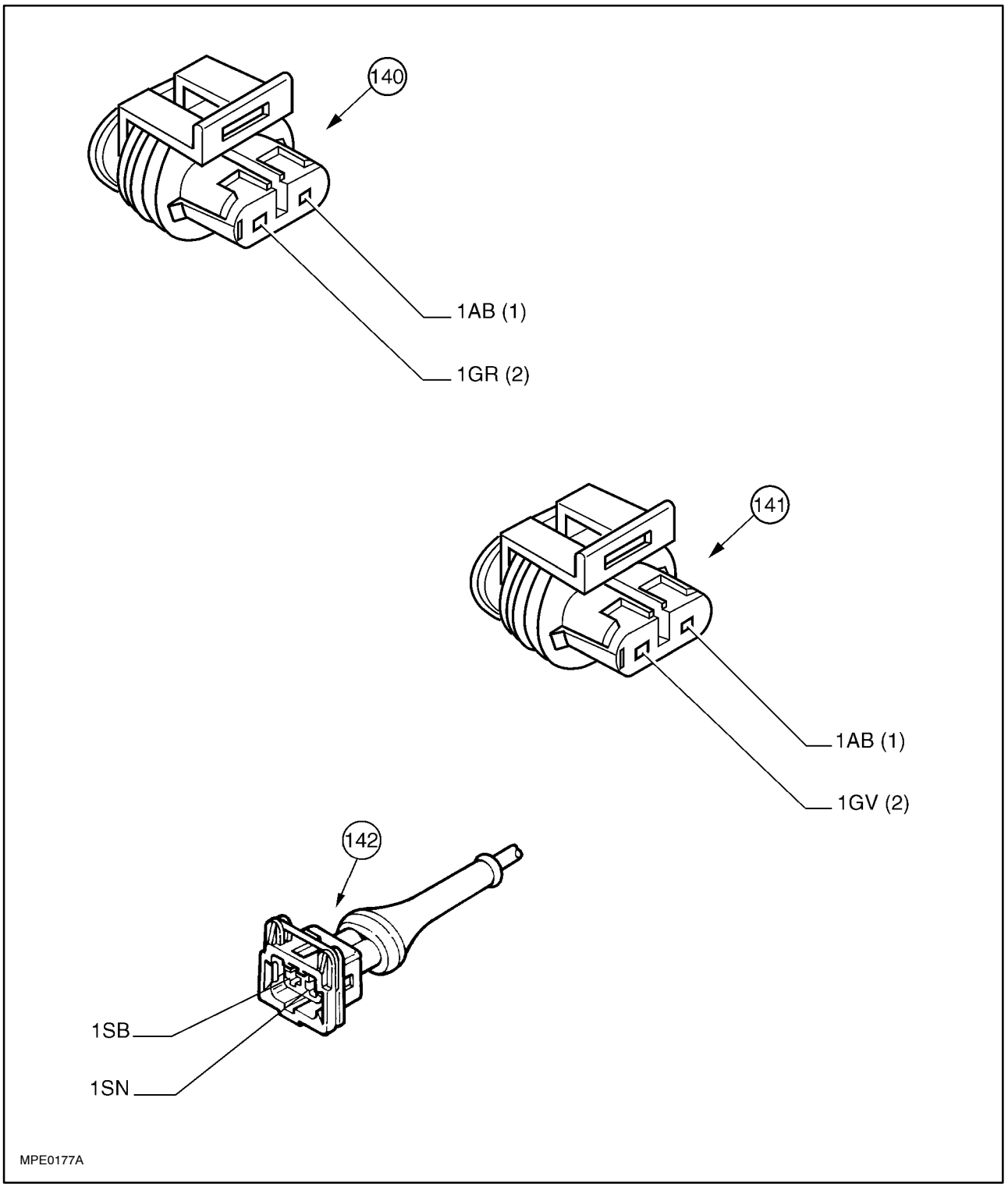
●● Version without cab (NASO)


132
1H
1HL
1HL
133
1HV
1HL
1HL
134
1AN (A)
1AG (B)
135
1BR (A)
1BN (B)
136
1BV (A)
1CN (B)
MPE0175A

129



130



131

WIRING DIAGRAM V

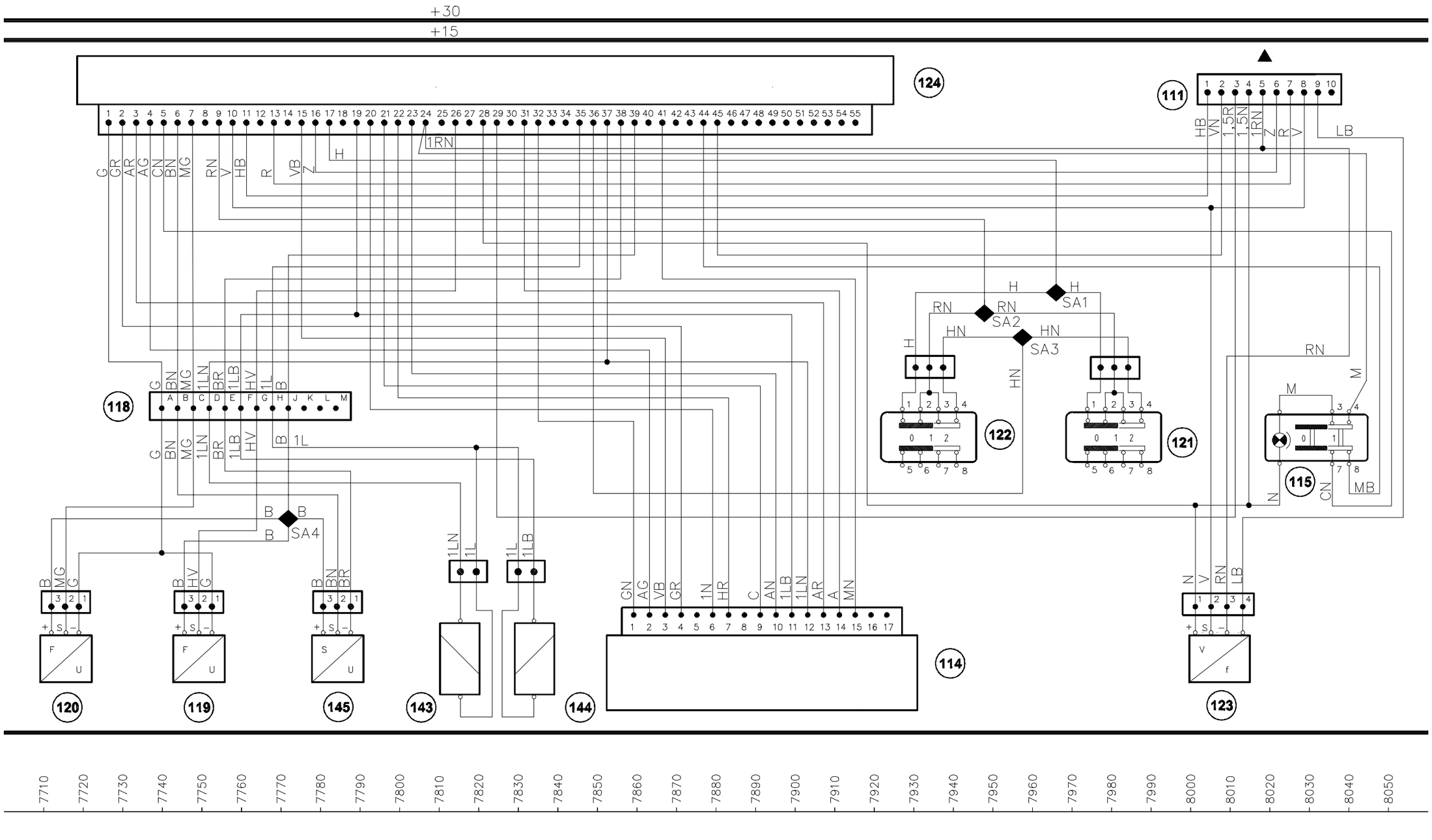
132

ELECTRONIC LIFT CIRCUIT (Model Bosch) (Diagram V)

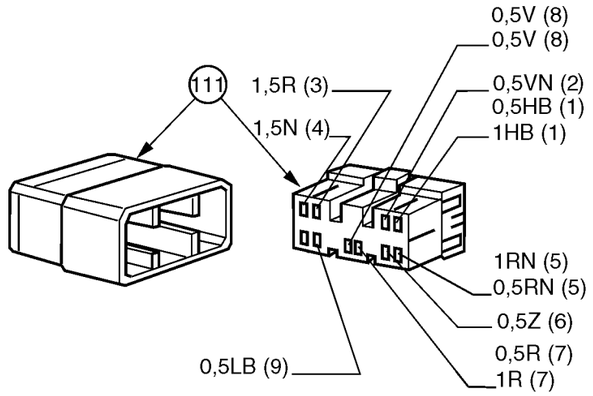
111 Electronic lift connection
114 Electronic lift control panel
115 Slip control switch
118 Sensors-control valve intermediate connection
119 RH draft sensor
120 LH draft sensor
121 Lift RH external control switch
122 Lift LH external control switch
123 Radar
124 Lift electronic control unit
143 Lift UP solenoid valve
144 Lift DOWN solenoid valve
145 Electronic lift position sensor

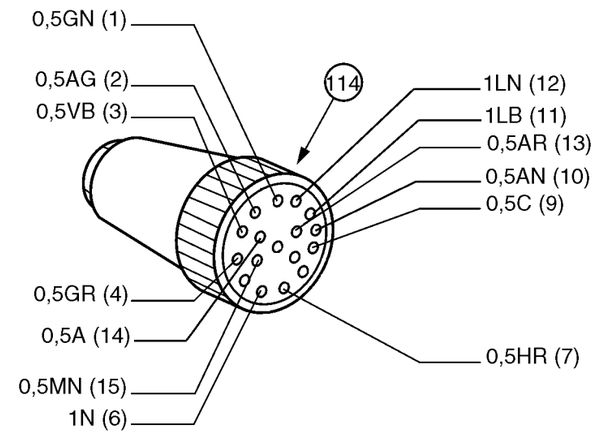
▲ See diagram K.

ELECTRONIC LIFT CIRCUIT (Model Bosch) - DIAGRAM V



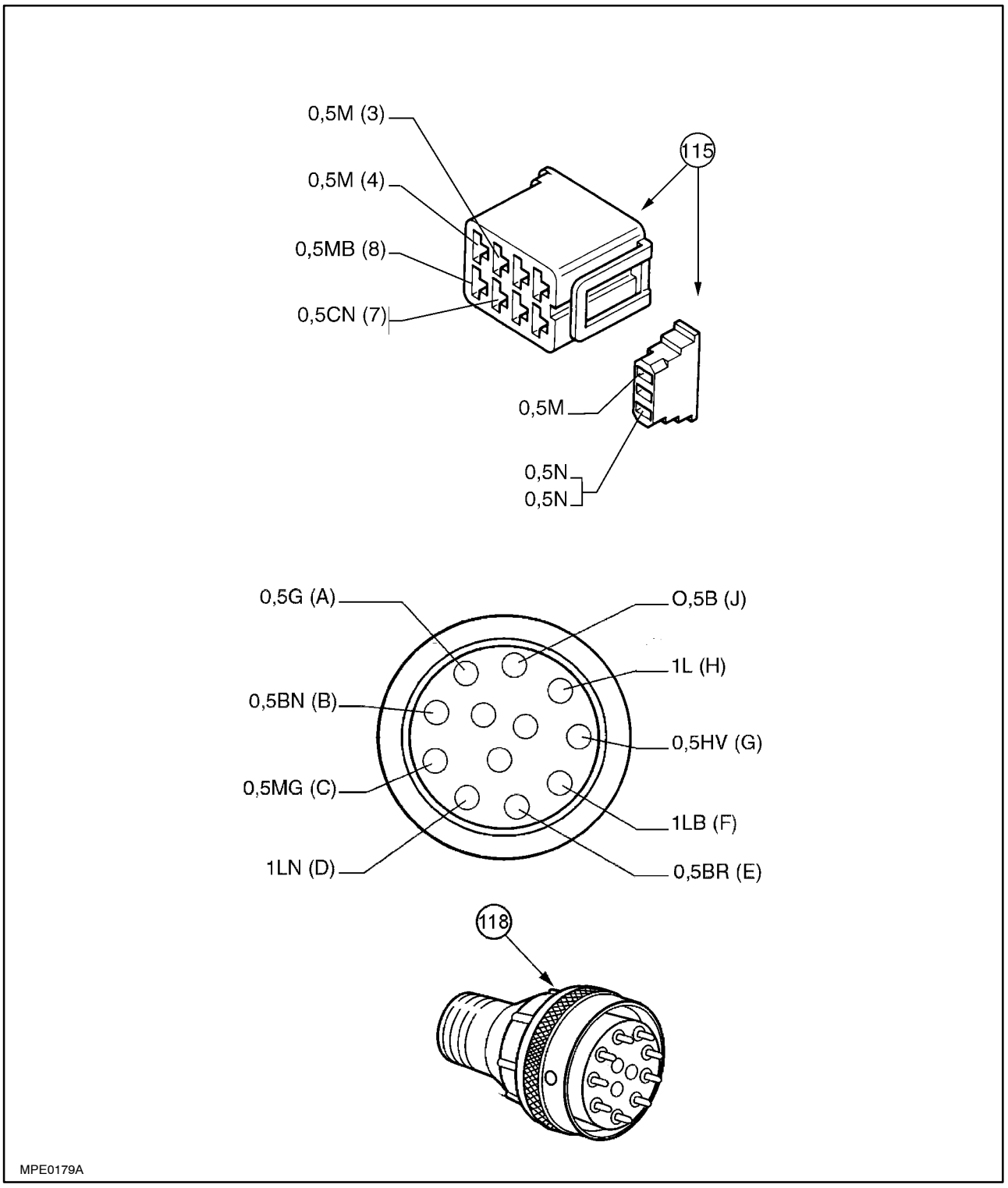
MPD3134A



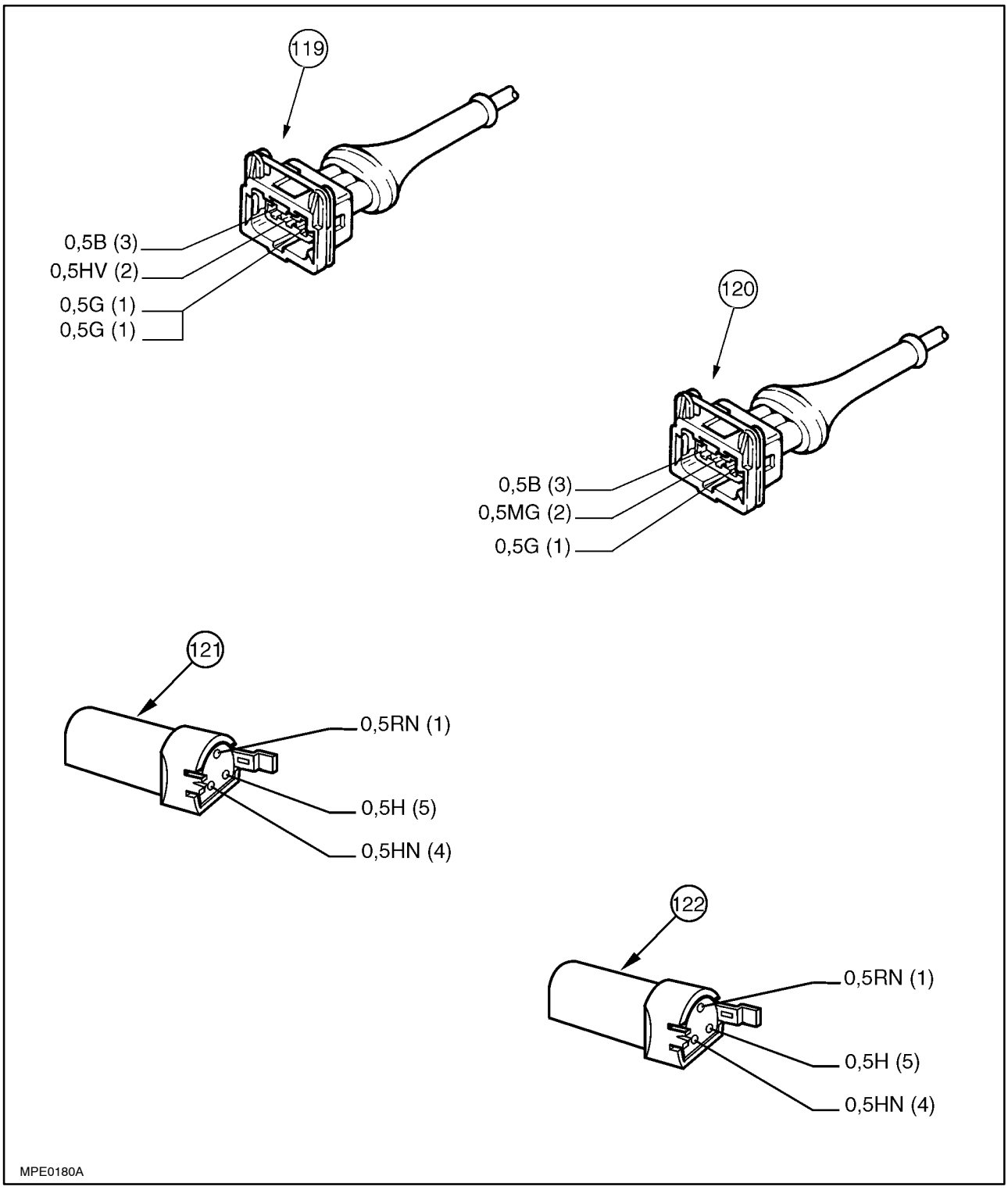


MPE0178A

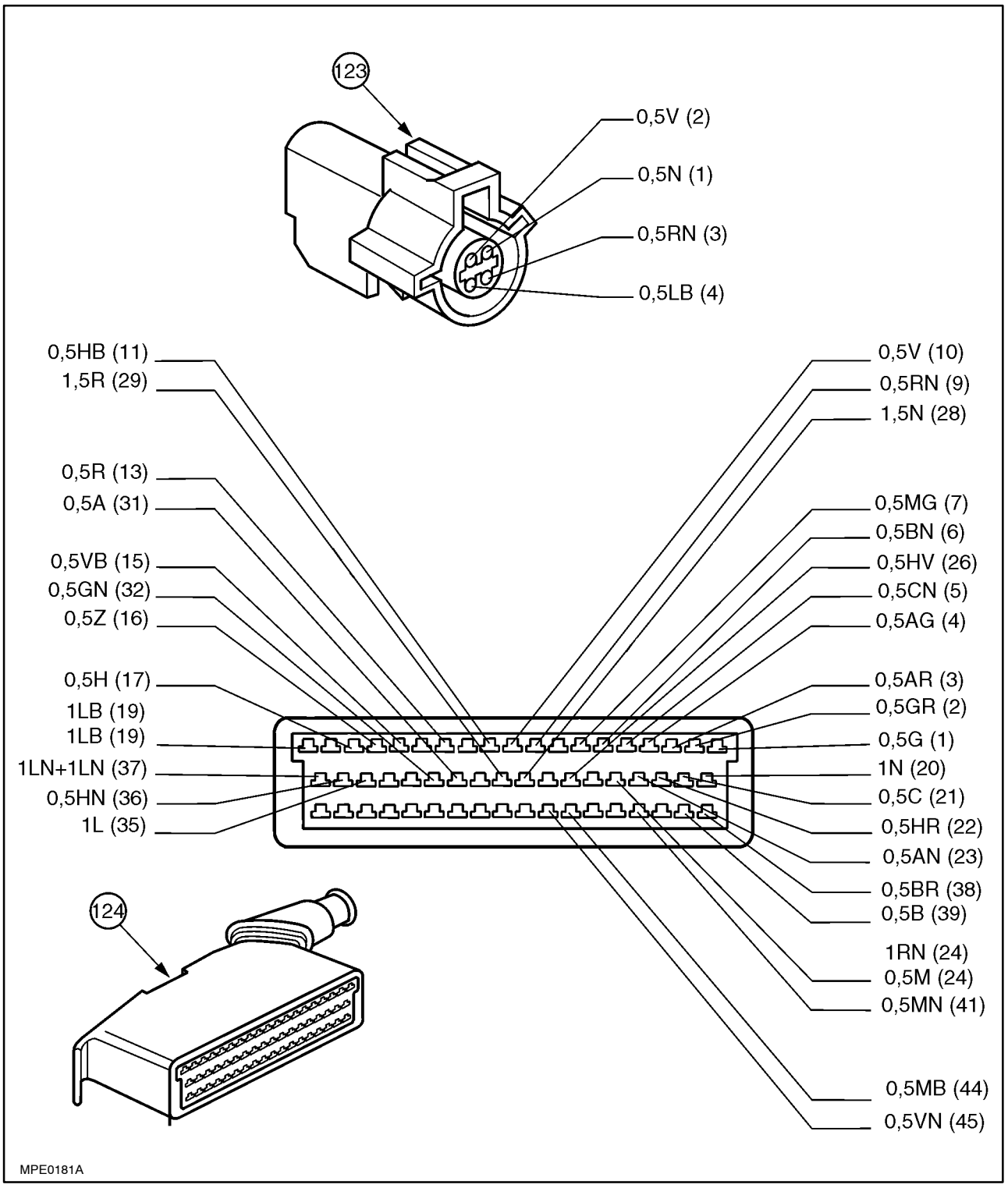
133


0,5M (3)
0,5M (4)
0,5MB (8)
0,5CN (7)
115
0,5M
0,5N
0,5N
0,5G (A)
O,5B (J)
1L (H)
0,5BN (B)
0,5HV (G)
0,5MG (C)
1LB (F)
1LN (D)
0,5BR (E)
118
MPE0179A

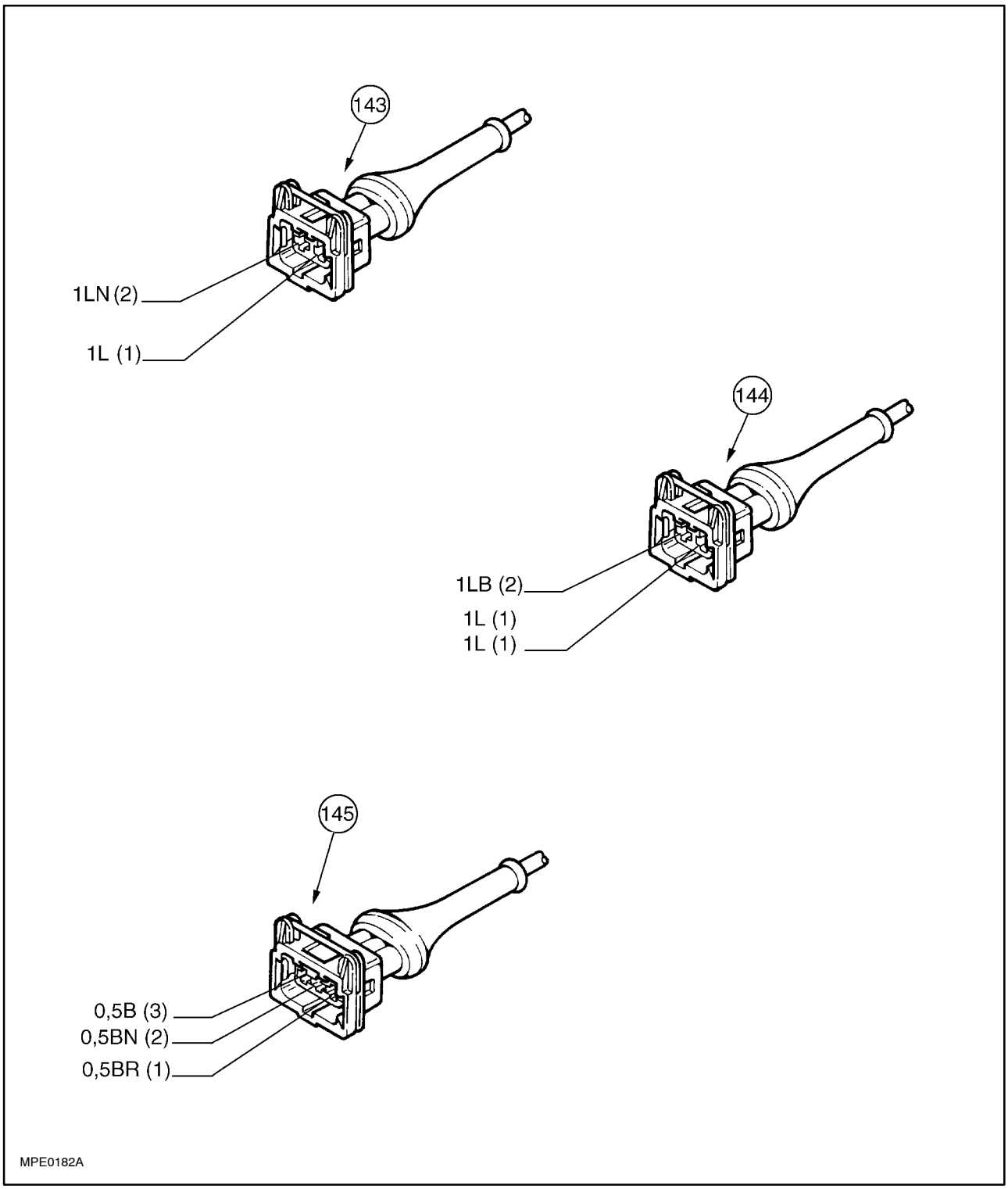
134


119
0,5B (3)
0,5HV (2)
0,5G (1)
0,5G (1)
120
0,5B (3)
0,5MG (2)
0,5G (1)
121
0,5RN (1)
0,5H (5)
0,5HN (4)
122
0,5RN (1)
0,5H (5)
0,5HN (4)
MPE0180A

135

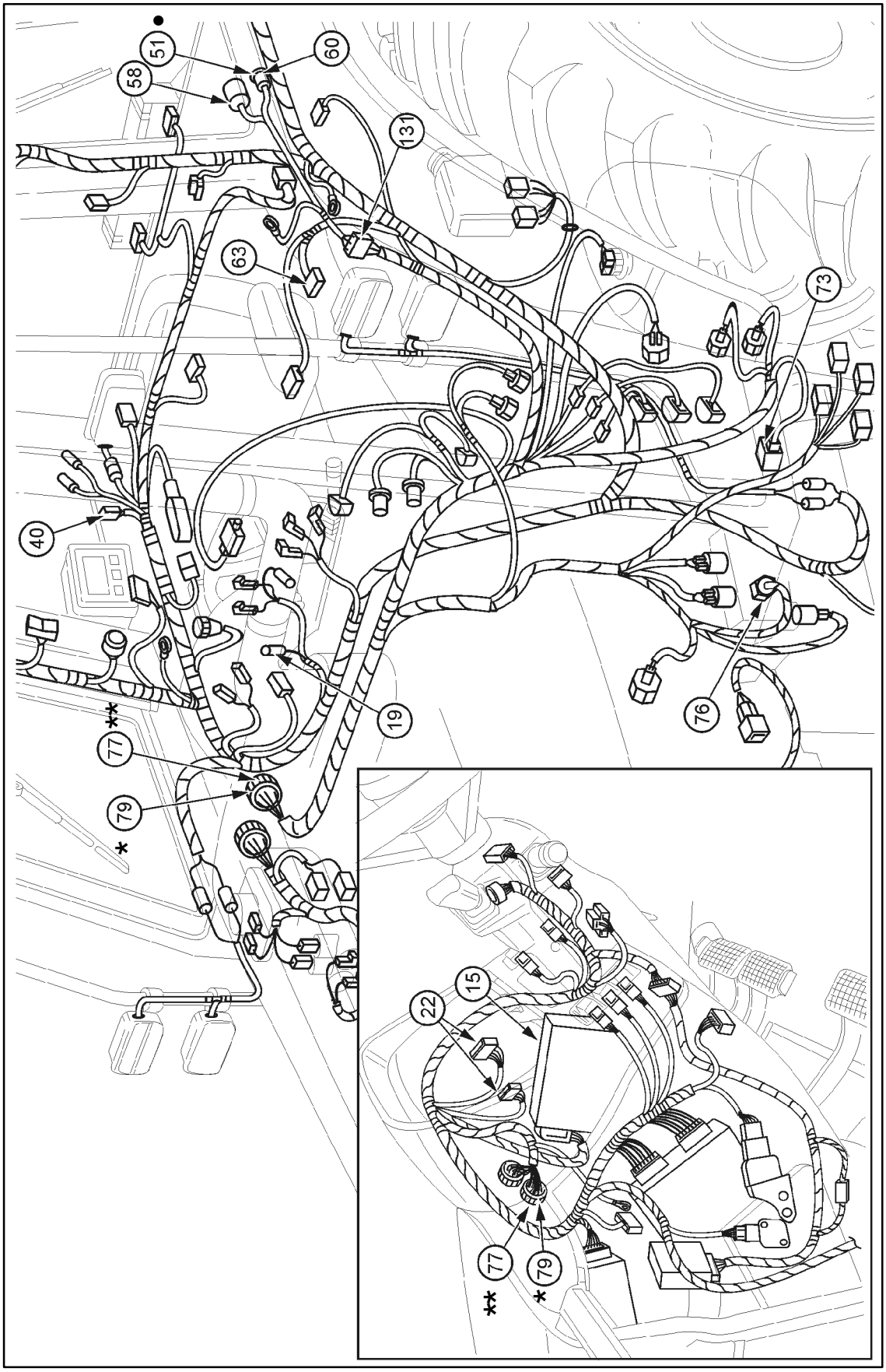

123
0,5V (2)
0,5N (1)
0,5RN (3)
0,5LB (4)
0,5HB (11)
1,5R (29)
0,5R (13)
0,5A (31)
0,5VB (15)
0,5GN (32)
0,5Z (16)
0,5H (17)
1LB (19)
1LB (19)
1LN+1LN (37)
0,5HN (36)
1L (35)
0,5V (10)
0,5RN (9)
1,5N (28)
0,5MG (7)
0,5BN (6)
0,5HV (26)
0,5CN (5)
0,5AG (4)
0,5AR (3)
0,5GR (2)
0,5G (1)
1N (20)
0,5C (21)
0,5HR (22)
0,5AN (23)
0,5BR (38)
0,5B (39)
1RN (24)
0,5M (24)
0,5MN (41)
0,5MB (44)
0,5VN (45)
124
MPE0181A

136



137

WIRING DIAGRAMS Z - X



138

- NASO version
- * For Power Shuttle version cabs (OHIO BILL CONFORMITY) and flatbeds (version ISO-NASO)
- ** For Dual Command (2 Speed Power Shift) version cabs (OHIO BILL CONFORMITY) and flatbeds with Dual Command (2 Speed Power Shift) (ISO version)

DUAL COMMAND (2 SPEED POWER SHIFT) CIRCUIT (Diagram Z)

15 Fuses and relay control unit
- F2 Dual Command (2 Speed Power Shift) circuit
- IX Dual Command (2 Speed Power Shift) circuit

19 Dual Command (2 Speed Power Shift) control switch

22 Instrument panel
- f High gear range ON [with Dual Command (2 Speed Power Shift)]
- g Low gear range ON [with Dual Command (2 Speed Power Shift)]

73 Dual Command (2 Speed Power Shift) solenoid valve

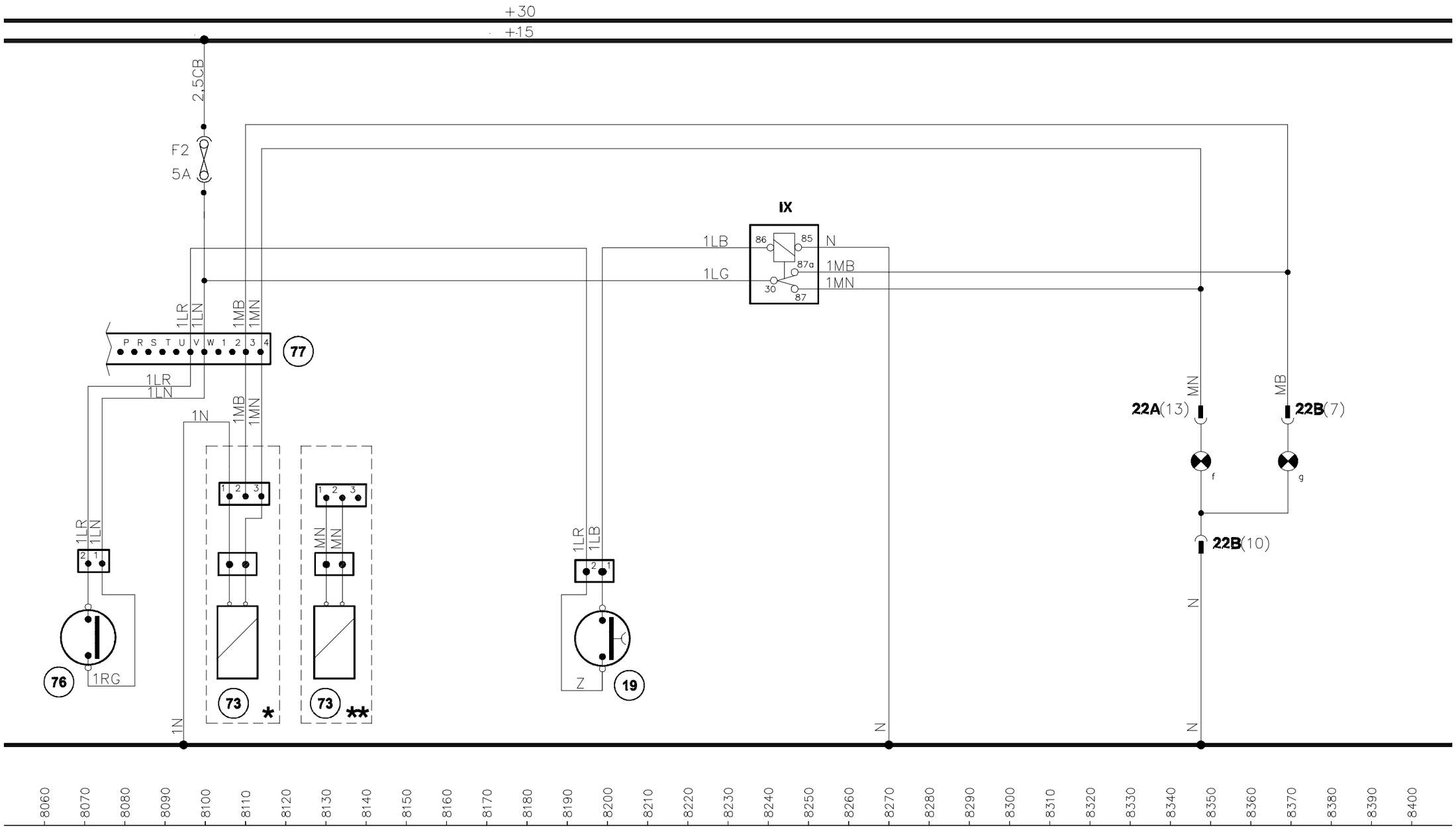
76 Reverser lever switch for Dual Command (2 Speed Power Shift)

77 Transmission side system connection (24 PIN)

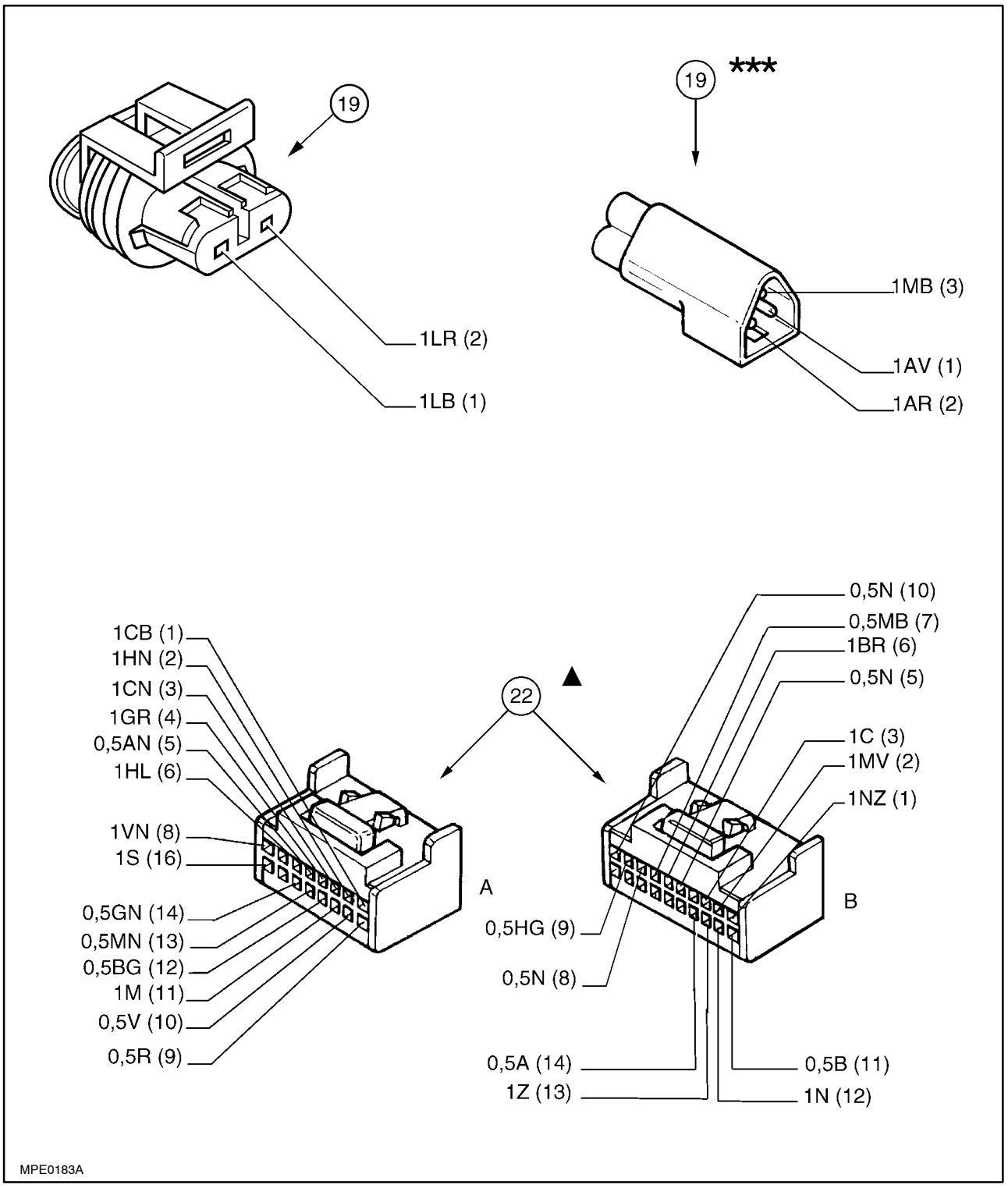
* 40 Km/h version.

** 30 Km/h version.

DUAL COMMAND (2 SPEED POWER SHIFT) CIRCUIT - DIAGRAM Z



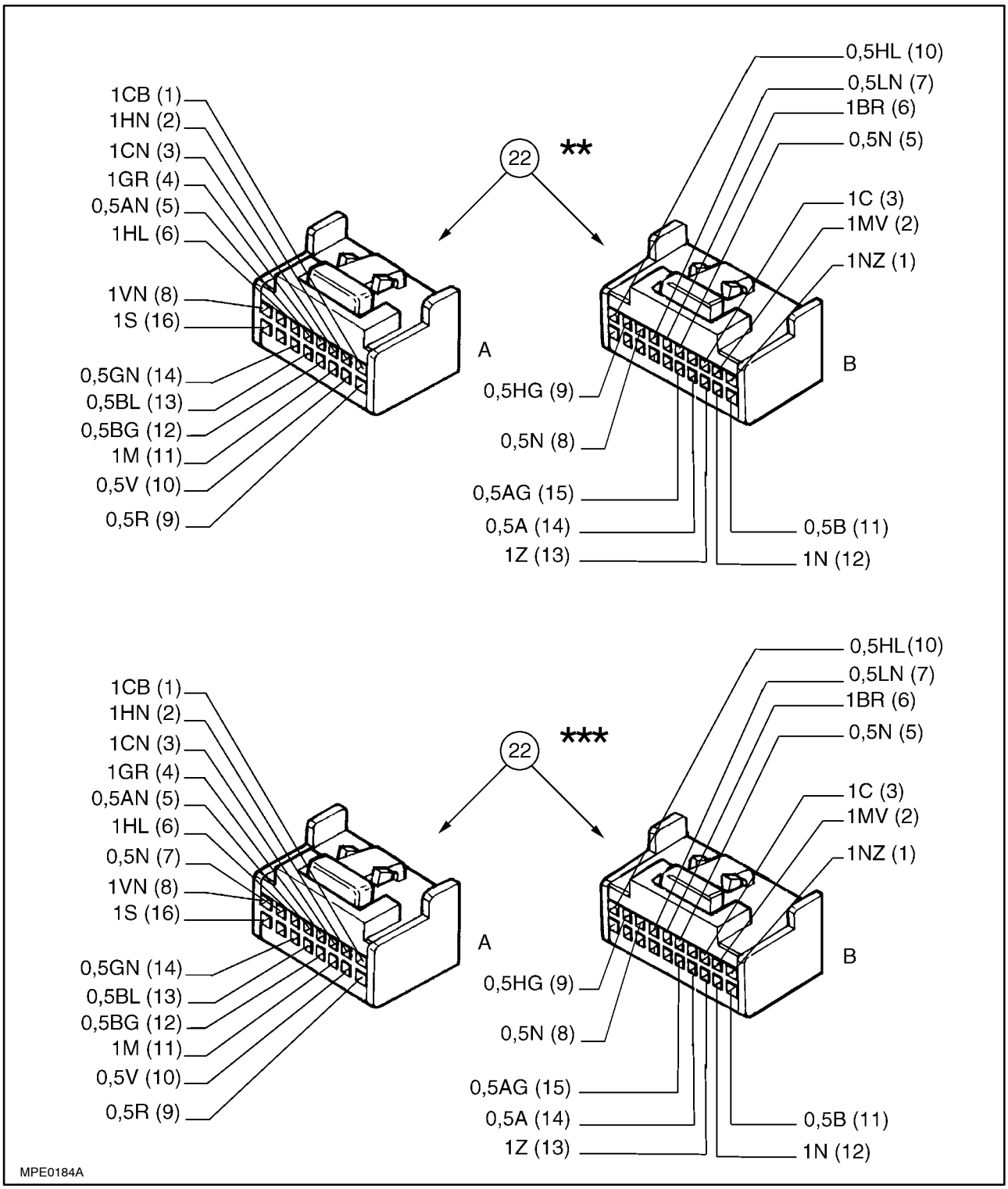
MPD3135A



139

*** Power Shuttle version

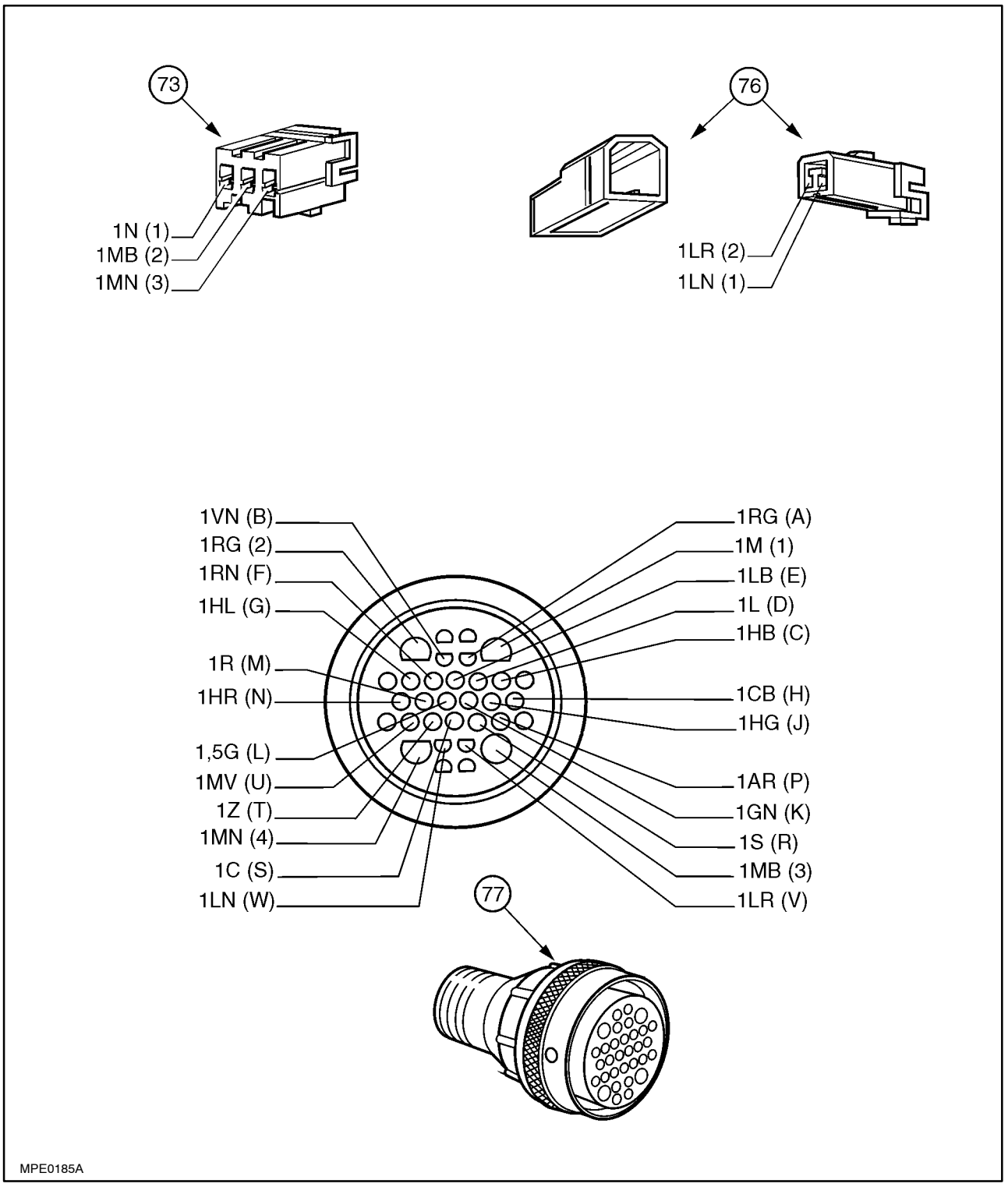
▲ Version with Dual Command (2 Speed Power Shift)



140

** Version without cab

*** Power Shuttle version


73
1N (1)
1MB (2)
1MN (3)
76
1LR (2)
1LN (1)
1VN (B)
1RG (2)
1RN (F)
1HL (G)
1R (M)
1HR (N)
1,5G (L)
1MV (U)
1Z (T)
1MN (4)
1C (S)
1LN (W)
1RG (A)
1M (1)
1LB (E)
1L (D)
1HB (C)
1CB (H)
1HG (J)
1AR (P)
1GN (K)
1S (R)
1MB (3)
1LR (V)
77
MPE0185A

141

POWER SOCKETS, SEVEN-POLE COUPLING (ISO - NASO) AND SEAT CIRCUIT (Diagram X)

15 Fuses and relay control unit
- F11 Horn, 8A power socket, cigar lighter, rotating beacon, overhead lighting, radio
- F21 Brake lights, seat

40 Auxiliary power socket (internal)

51 4-pole power socket 40 A (NASO)

58 Seven-pole socket

60 2-pole power socket 25A (ISO)

63 Seat connection

77 Transmission side system connection (24 PIN)

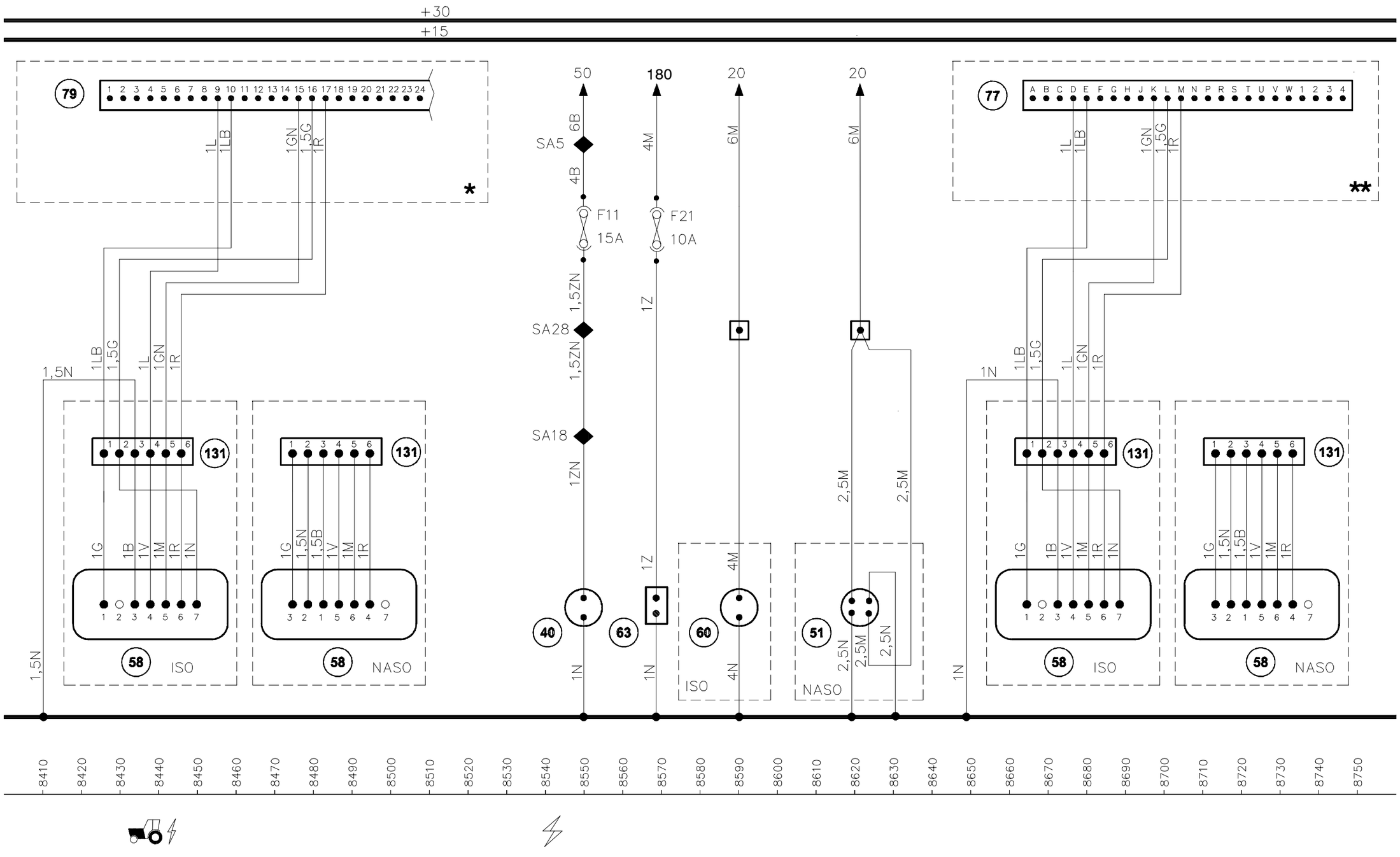
79 Transmission side system connection (48 PIN)

131 Connection for 7-pole connector

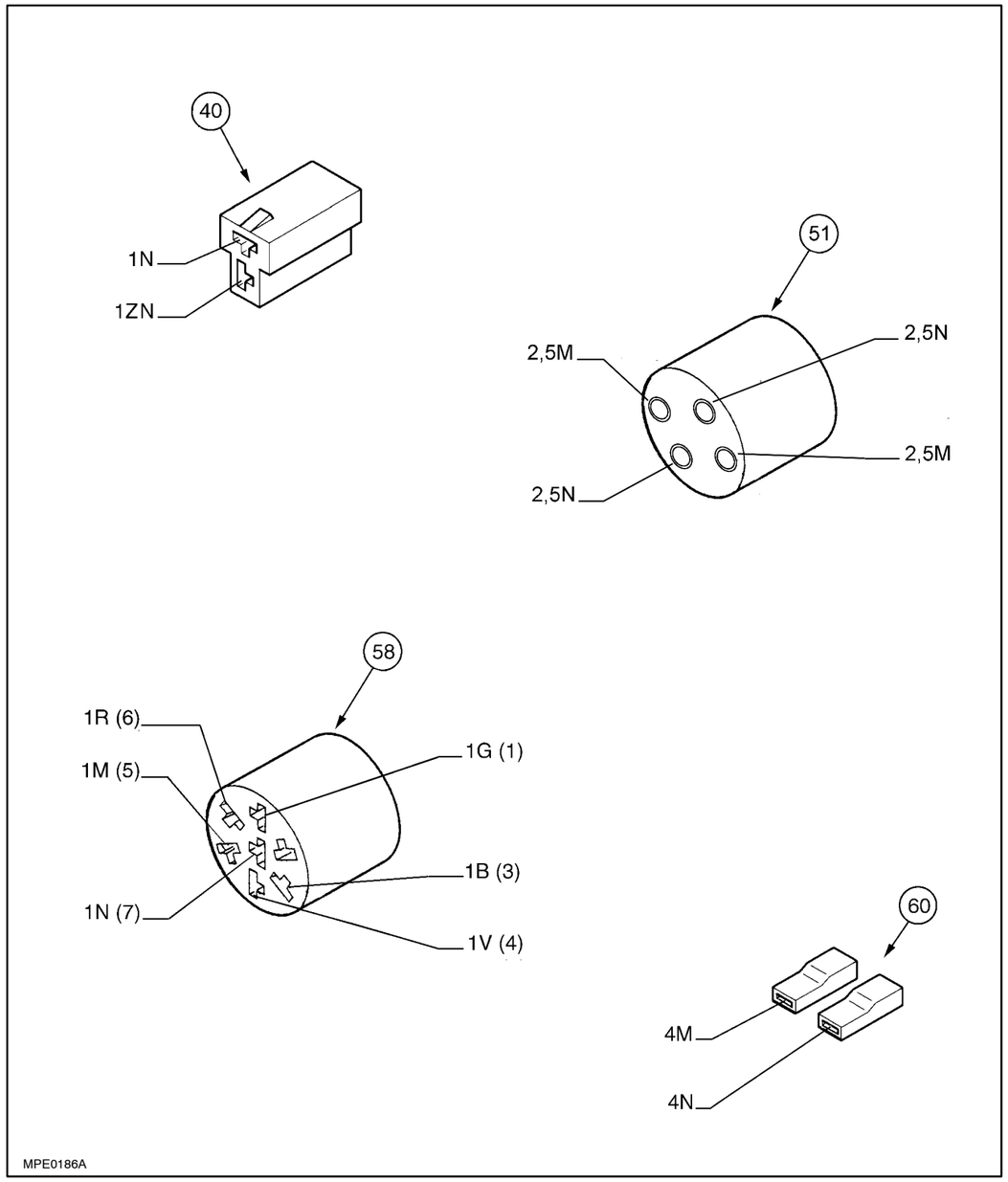
* For cab versions with Power Shuttle (OHIO BILL CONFORMITY) and flatbeds (ISO-NASO version).

** For cab versions with Dual Command (2 Speed Power Shift) (OHIO BILL CONFORMITY) and flatbeds with Dual Command (2 Speed Power Shift) (ISO version).

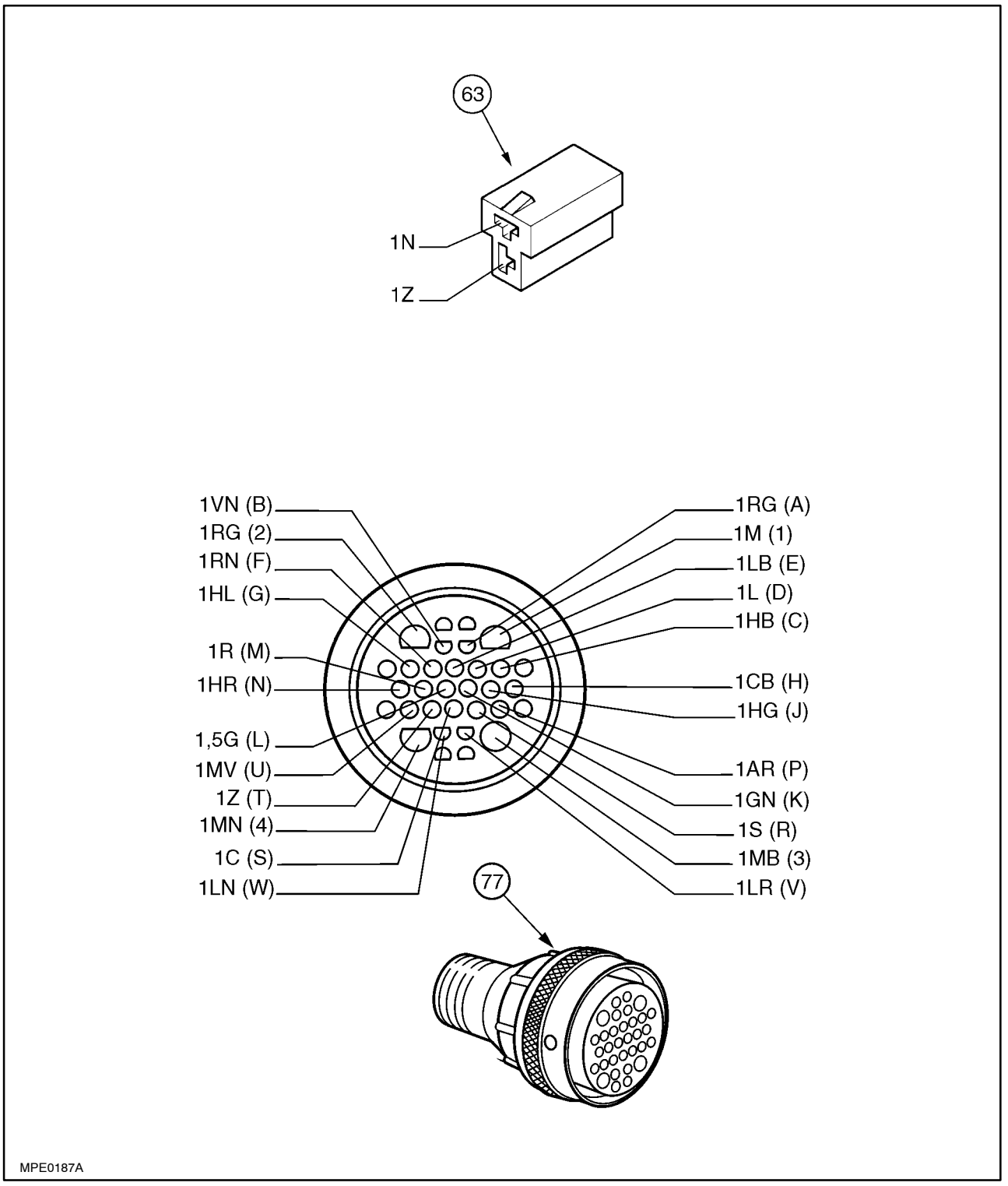
POWER SOCKETS, SEVEN-POLE COUPLING CIRCUIT (ISO - NASO) AND SEAT - DIAGRAM X



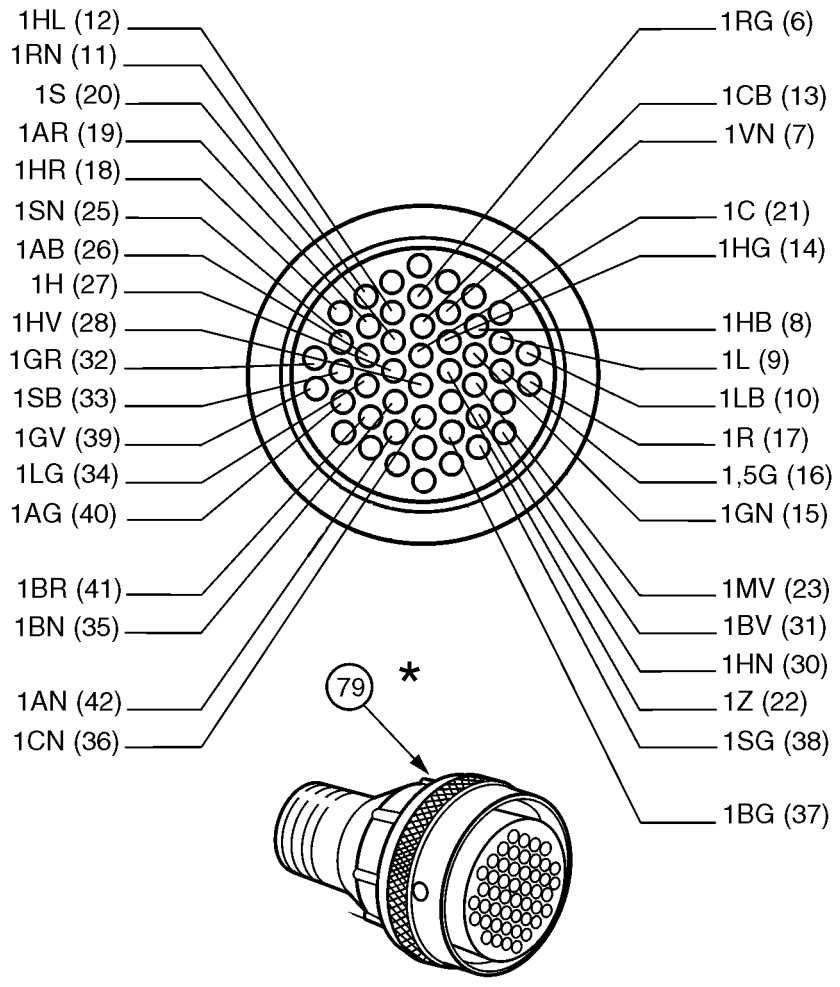
MPD31369A


40
1N
1ZN
51
2,5M
2,5N
2,5N
2,5M
58
1R (6)
1M (5)
1N (7)
1G (1)
1B (3)
1V (4)
60
4M
4N
MPE0186A

142

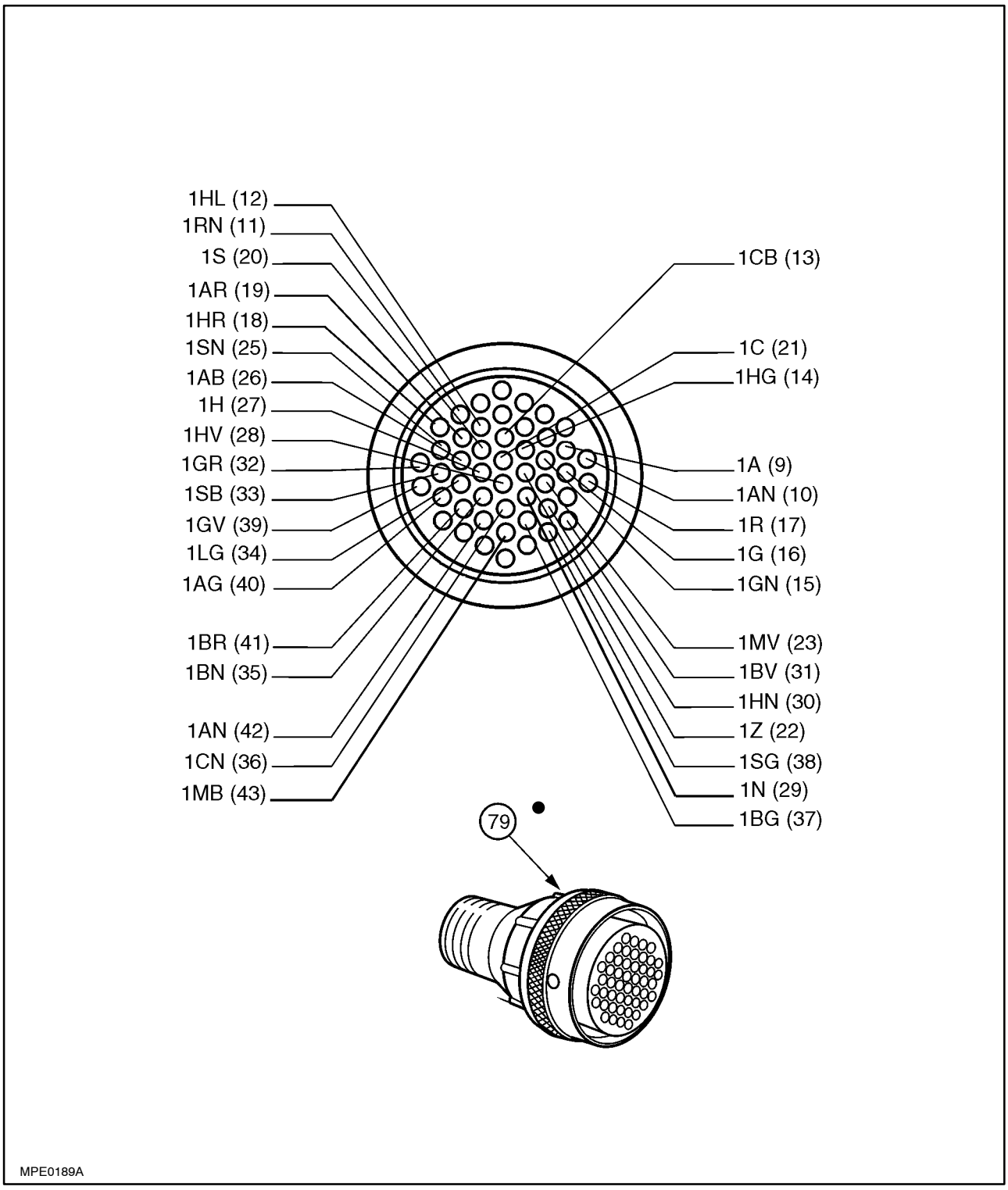

63
1N
1Z
1VN (B)
1RG (2)
1RN (F)
1HL (G)
1R (M)
1HR (N)
1,5G (L)
1MV (U)
1Z (T)
1MN (4)
1C (S)
1LN (W)
1RG (A)
1M (1)
1LB (E)
1L (D)
1HB (C)
1CB (H)
1HG (J)
1AR (P)
1GN (K)
1S (R)
1MB (3)
1LR (V)
77
MPE0187A

143



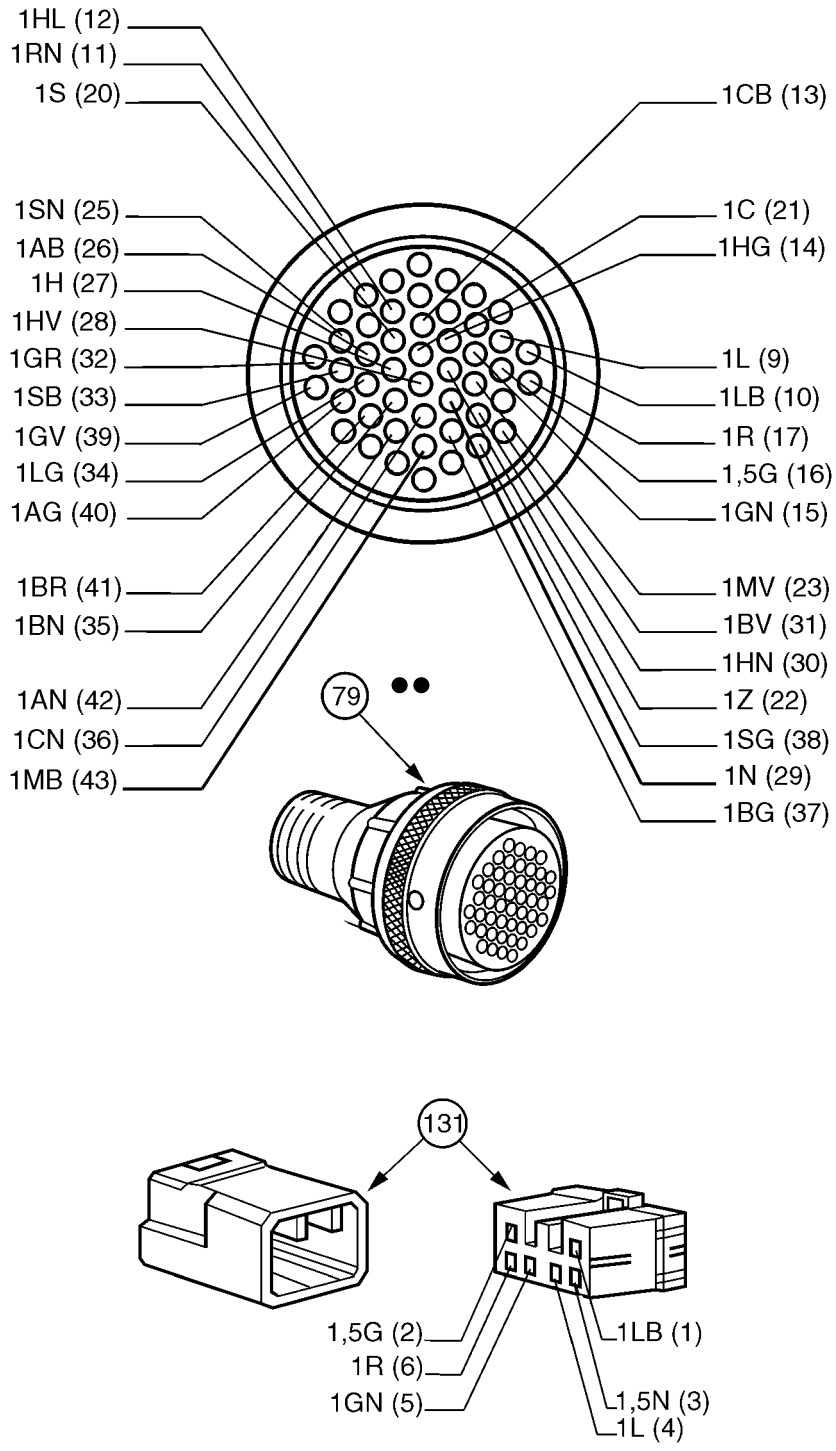
144

* Version with cab



145

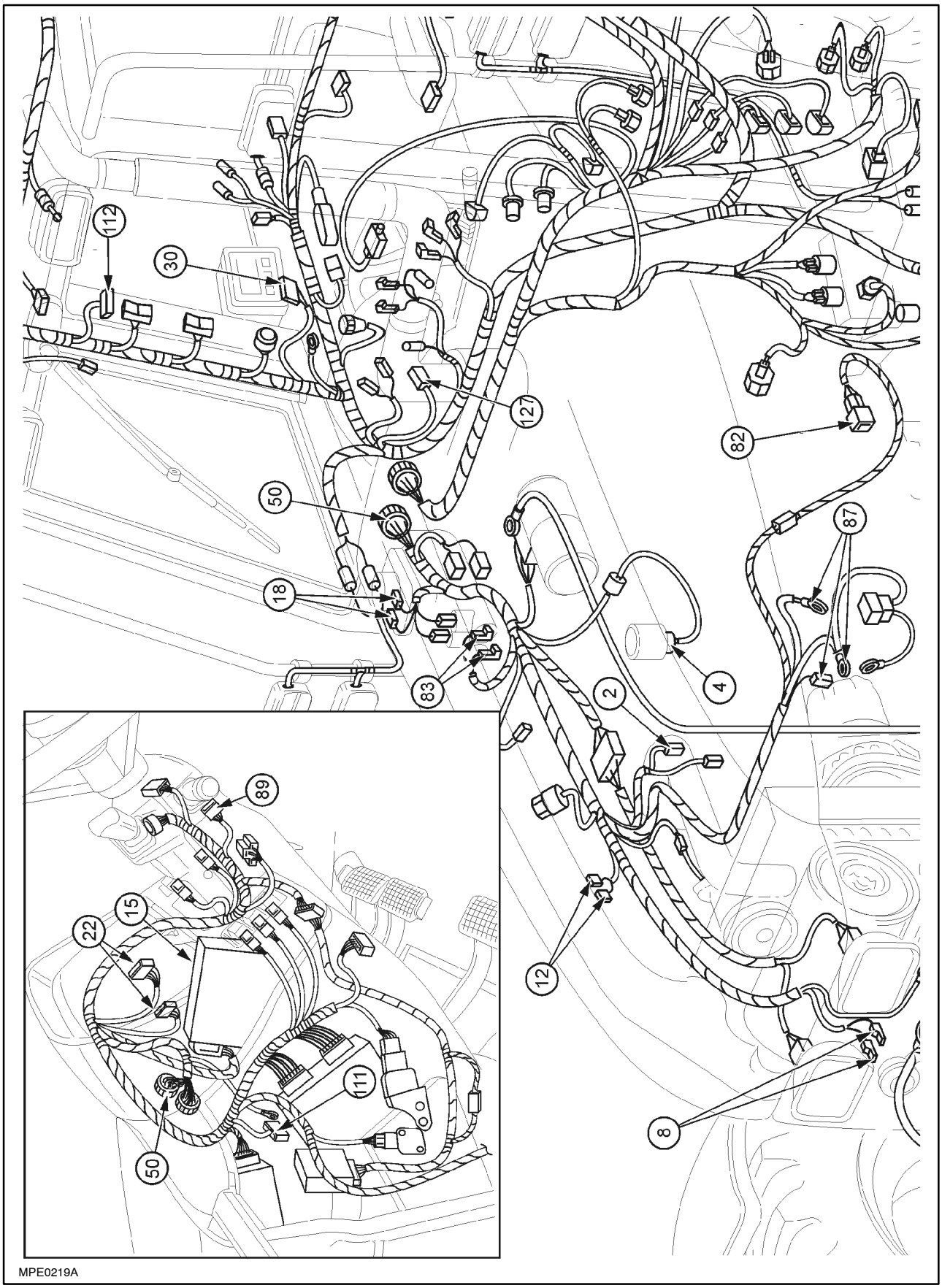
- Version without cab (ISO)



146

●● Version without cab (NASO)

WIRING DIAGRAMS Y - K



147

HORN, SENSORS AND TRANSMITTERS CIRCUIT (Diagram Y)

2 Engine coolant temperature sensor

4 Sediment unit filter sensor

8 Horn

12 Air filter clogged sensor

15 Fuses and relay control unit

- F11 Horn, 8A power socket, cigar lighter, rotating beacon, overhead lighting, radio
- F12 Trailer brake circuit, instruments, seat safety circuit
- F16 Sediment unit, compressor conditioner circuit

18 Brake fluid level sensor

22 Instrument panel

- o Low engine oil pressure
- n Water in fuel
- q Air filter clogged
- t Brake fluid level low
- v Dual Command (2 Speed Power Shift) rear transmission oil pressure low

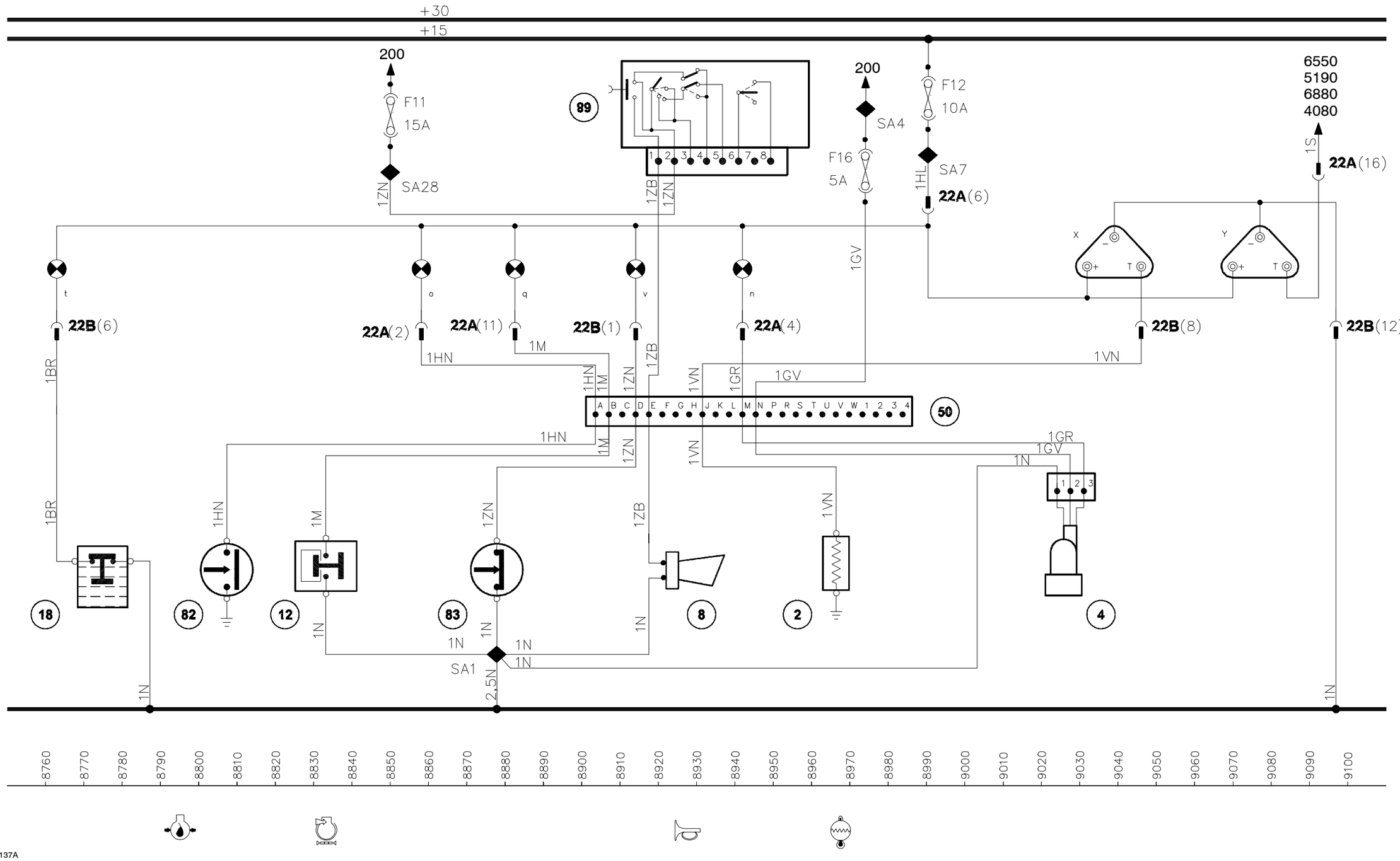
50 Front main connection (24 PIN)

82 Oil pressure sensor

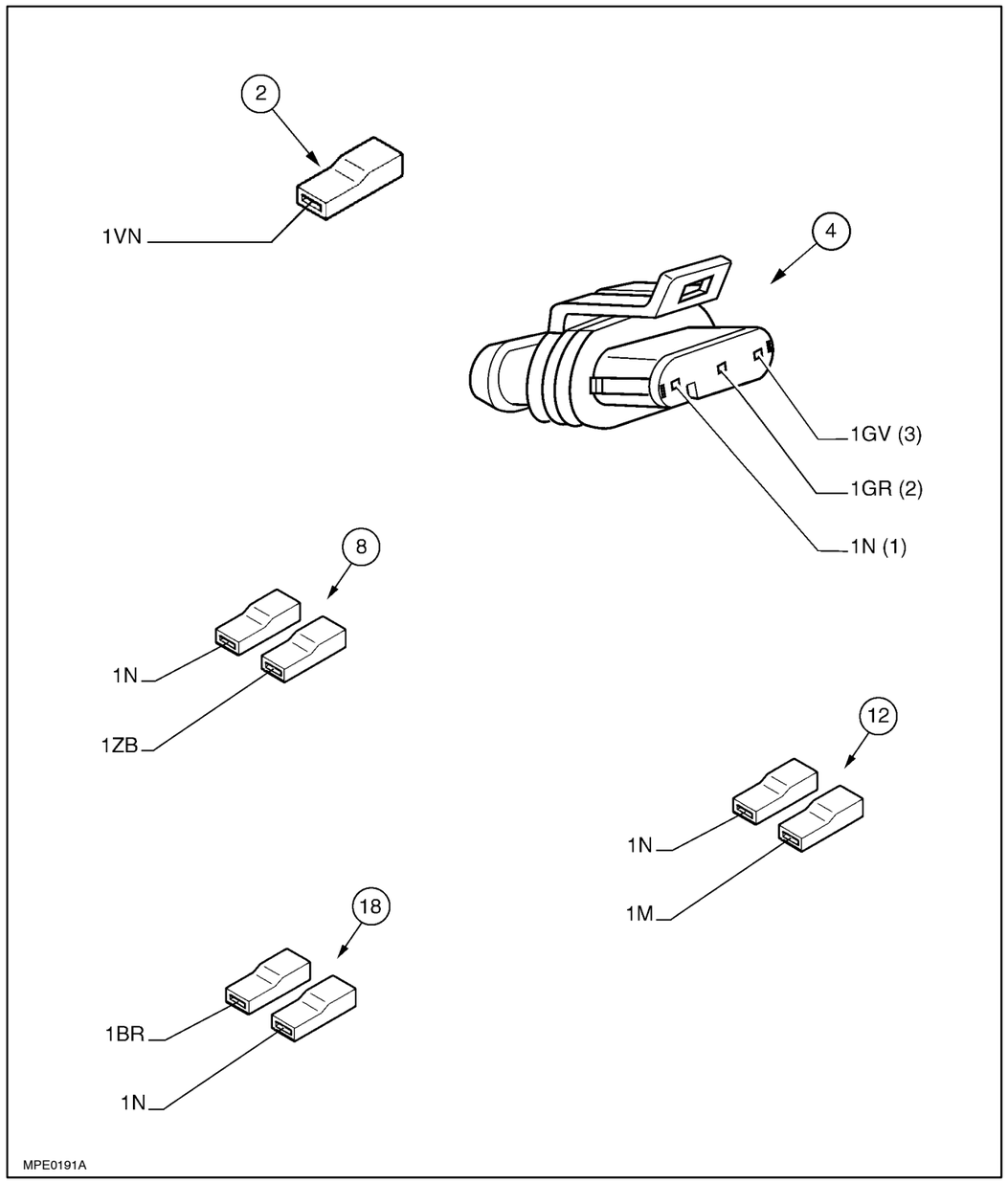
83 Gearbox oil pressure switch

89 External lights control switch

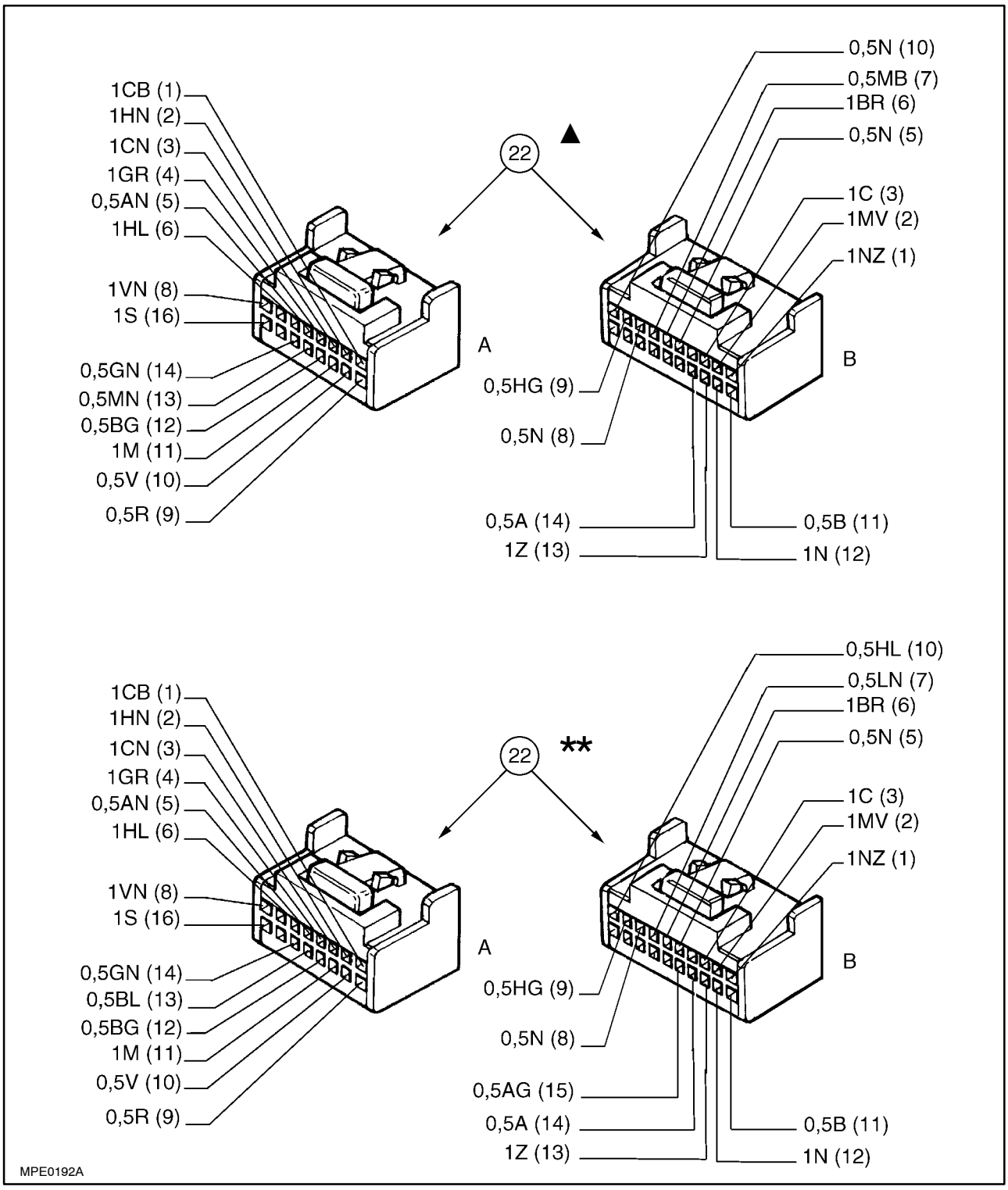
HORN, SENSORS AND TRANSMITTERS CIRCUIT - DIAGRAM Y



MPD3137A



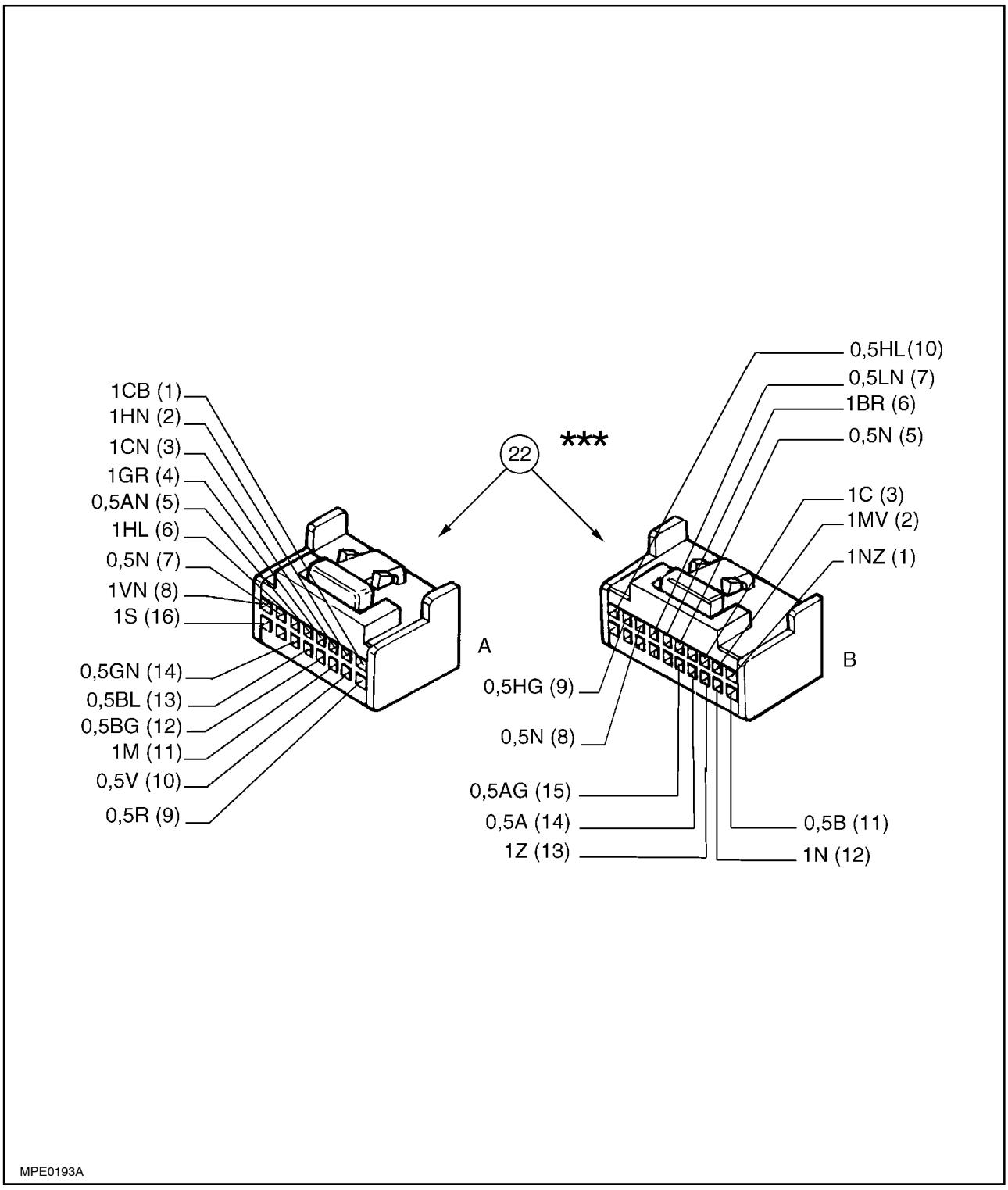
148



149

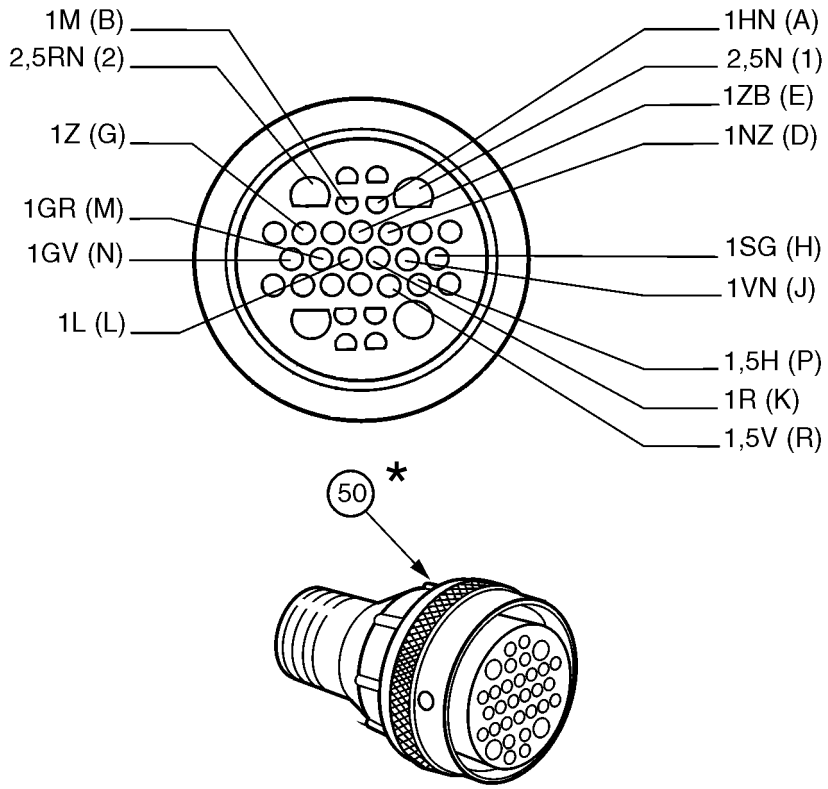
▲ Version with Dual Command (2 Speed Power Shift)

** Version without cab



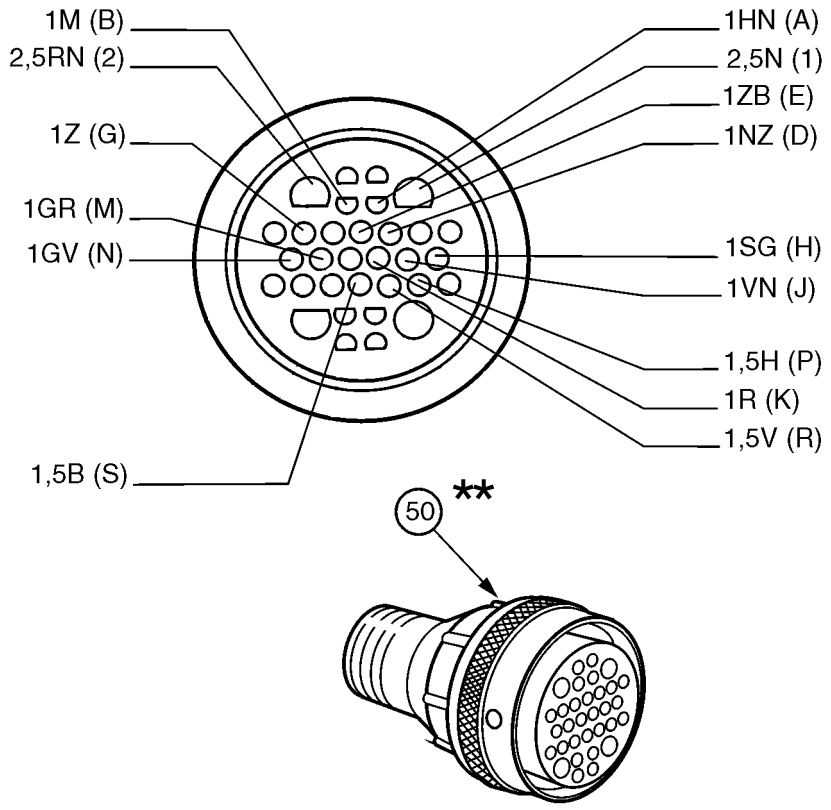
150

*** Power Shuttle version



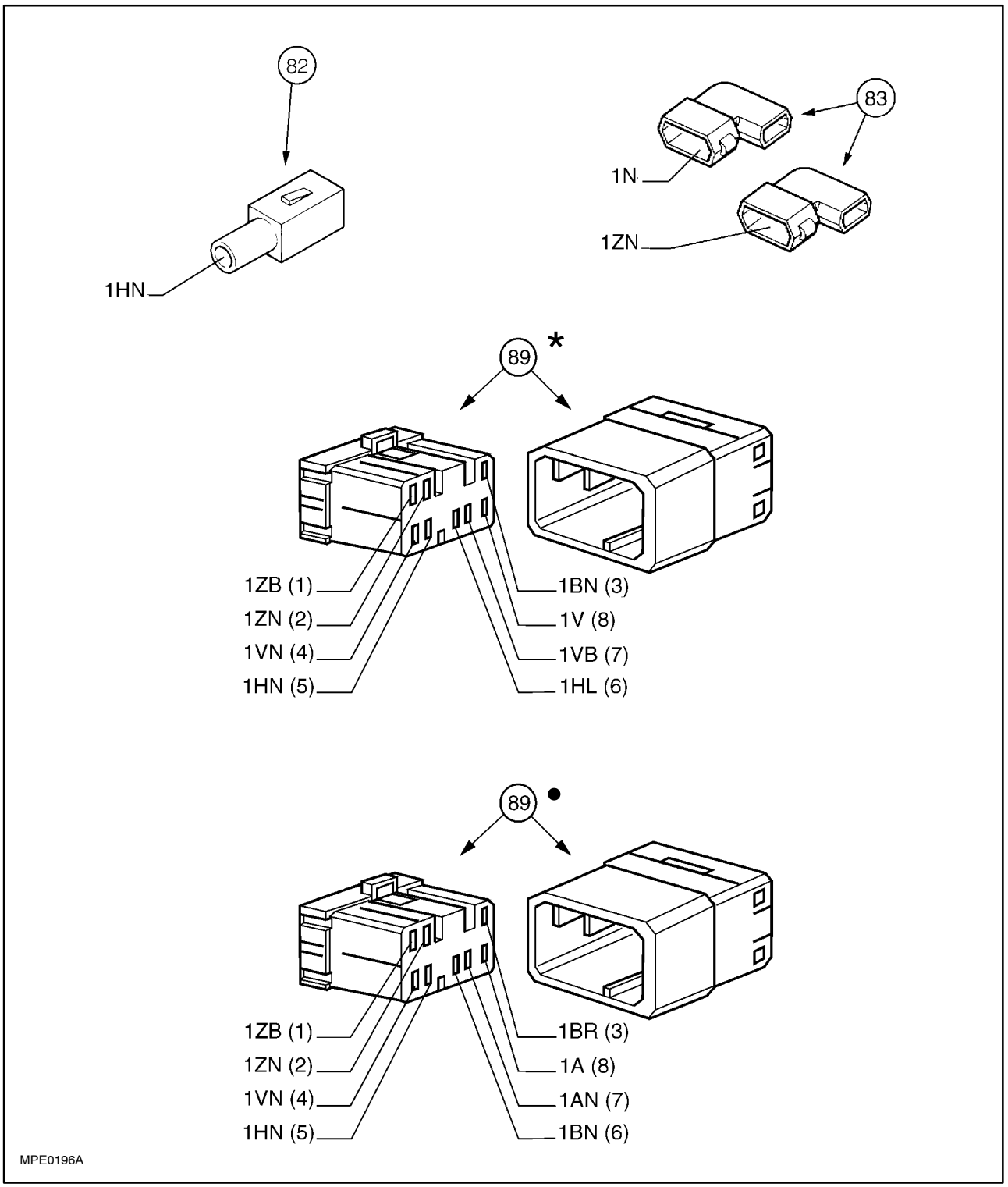
151

* Version with cab



152

** Version without cab



153

* Version with cab

● Version without cab (ISO)

DIGITAL INSTRUMENT, DIGITAL CLOCK CIRCUIT (Diagram K)

15 Fuses and relay control unit
- F9 Electronic lift circuit and Power Shuttle (+ Battery)
- F11 Horn, 8A power socket, cigar lighter, rotating beacon, overhead lighting, radio
- F14 Electronic lift circuit, (+ key)
- F20 Digital instrument circuit

30 Digital instrument

87 Alternator

111 Electronic lift connection

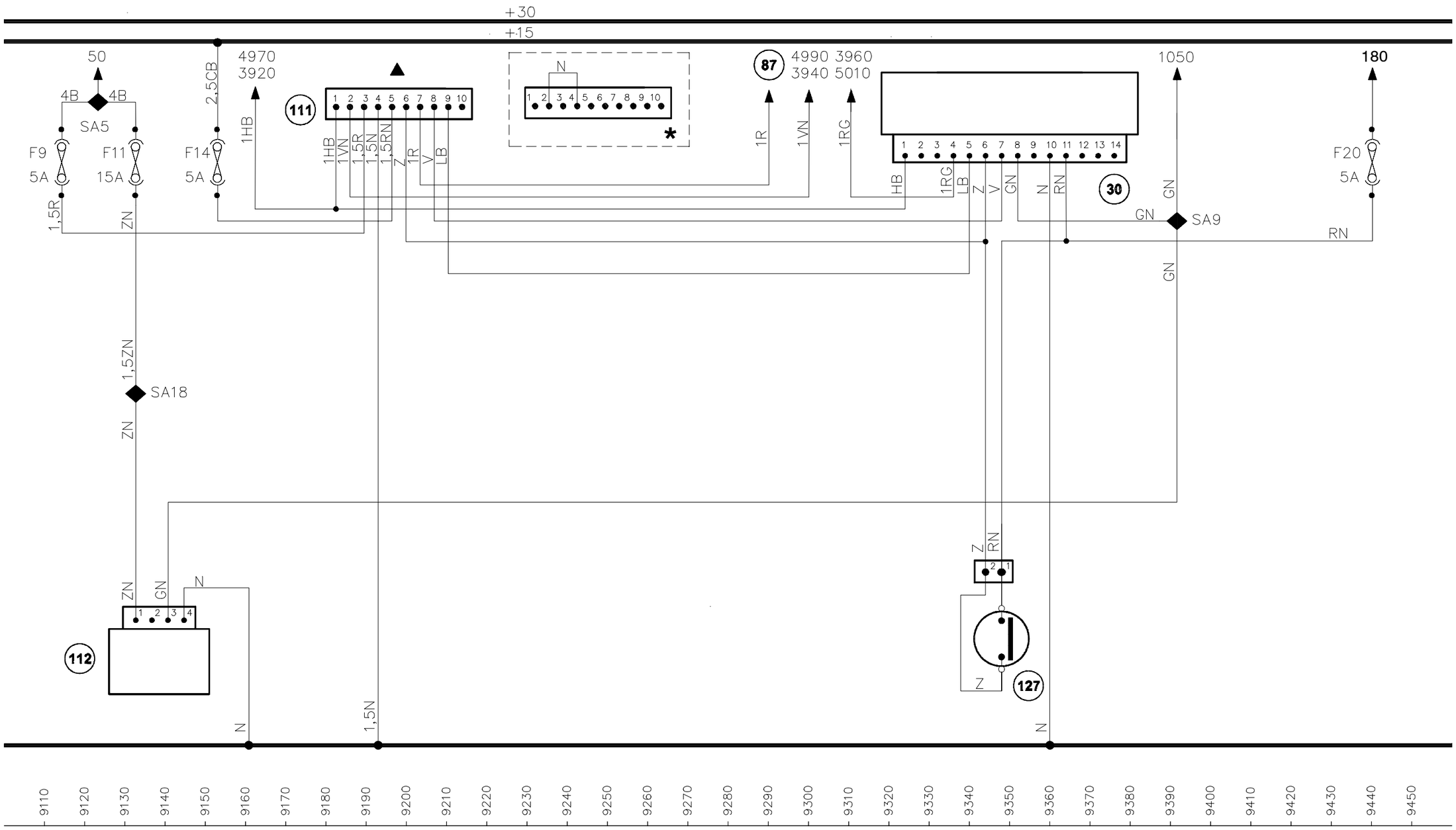
112 Digital clock

127 Lift status switch

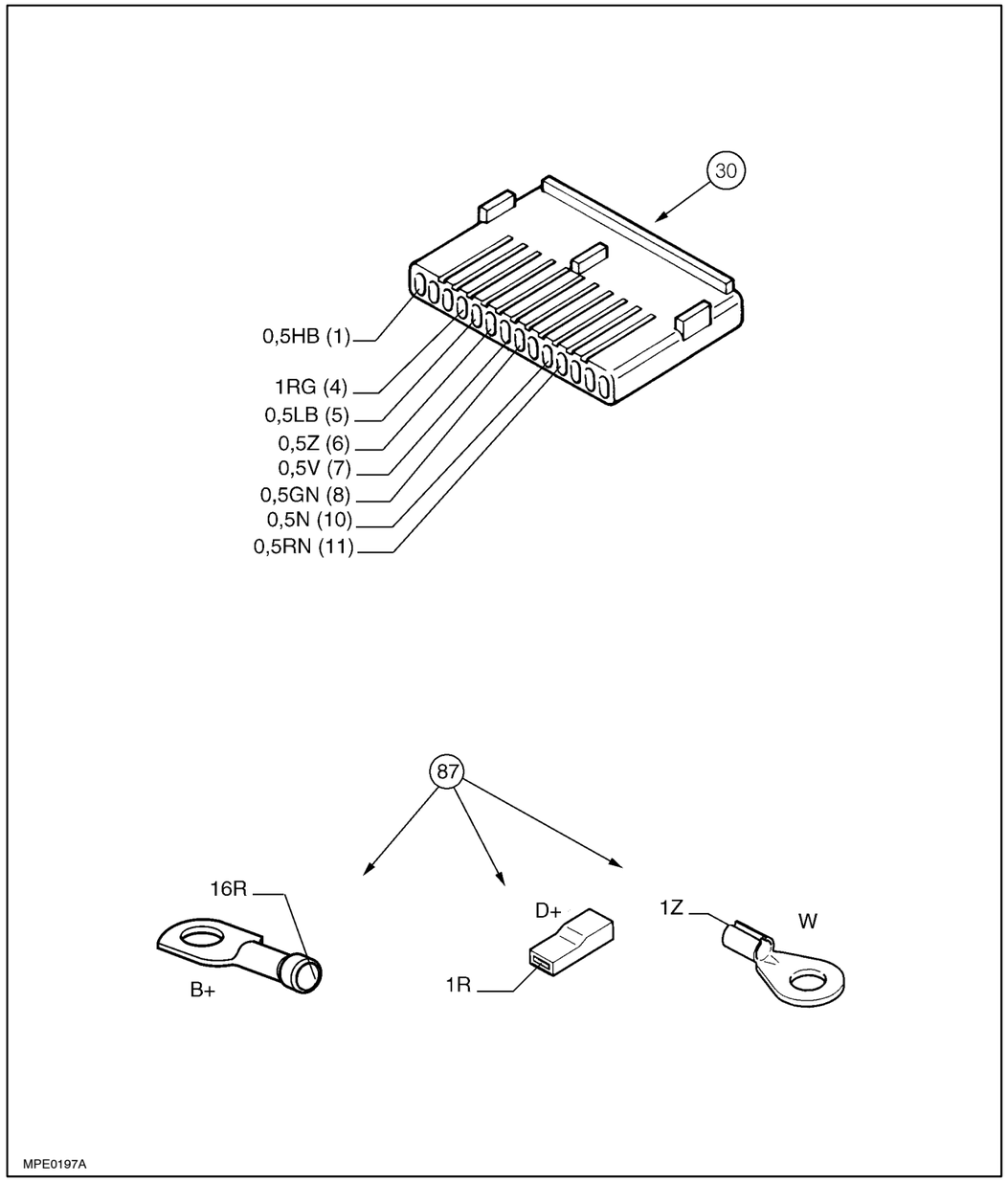
▲ See diagram V.

* Jumper to eliminate for version with electronic lift.

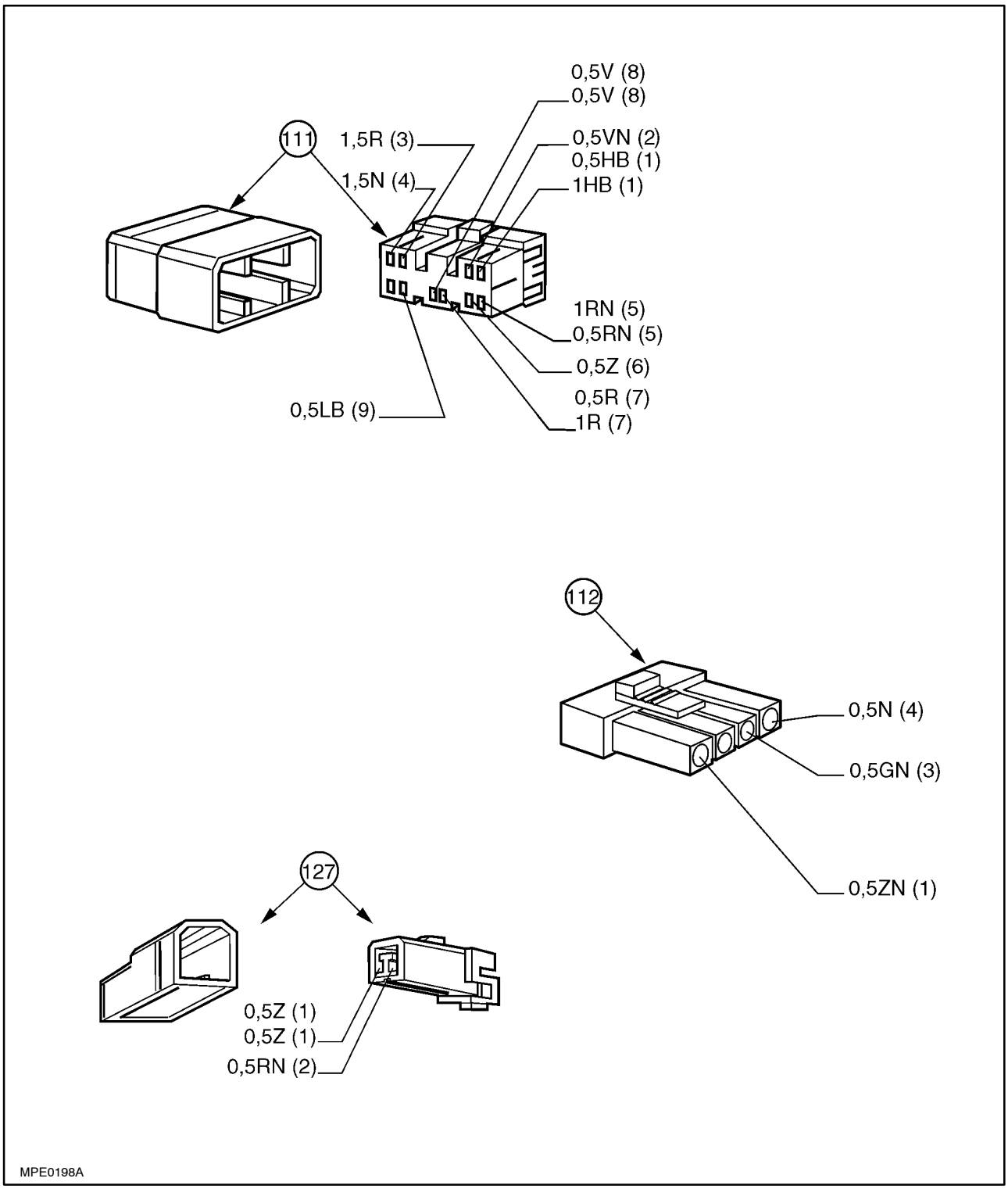
DIGITAL INSTRUMENT, DIGITAL CLOCK CIRCUIT - DIAGRAM K



MPD3138A


30
0,5HB (1)
1RG (4)
0,5LB (5)
0,5Z (6)
0,5V (7)
0,5GN (8)
0,5N (10)
0,5RN (11)
87
16R
B+
D+
1R
1Z
W
MPE0197A

154

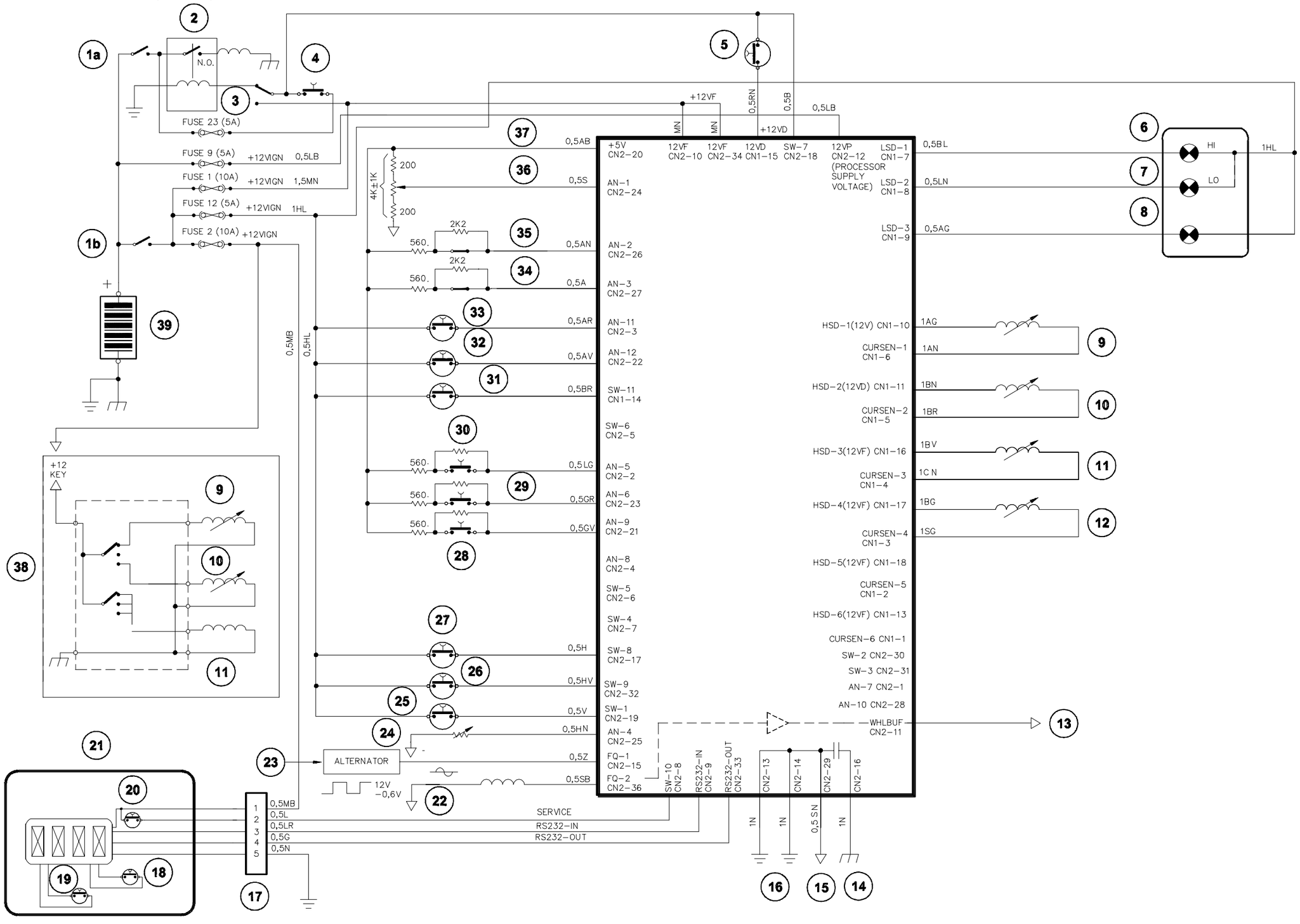

111
1,5R (3)
1,5N (4)
0,5V (8)
0,5V (8)
0,5VN (2)
0,5HB (1)
1HB (1)
1RN (5)
0,5RN (5)
0,5Z (6)
0,5R (7)
1R (7)
0,5LB (9)
112
0,5N (4)
0,5GN (3)
0,5ZN (1)
127
0,5Z (1)
0,5Z (1)
0,5RN (2)
MPE0198A

155

POWER SHUTTLE (24 + 24) ELECTRONIC CONTROL UNIT INPUT/OUTPUT CIRCUIT (Diagram W)

1 Start switch. 1a: starter function – 1b. gear function
2 Starter relay
3 Shuttle control lever
4 Clutch control pedal switch
5 Clutch control pedal switch
6 HIGH speed ON indicator signal
7 LOW speed ON indicator signal
8 Transmission alarm indicator light
9 Clutch A (forward gears) solenoid valve
10 Clutch B (reverse gears) solenoid valve
11 Clutch C control solenoid valve
12 Clutch D control solenoid valve
13 Speed sensor amplified signal
14 Bodywork ground
15 Sensors ground
16 Power ground
17 Connection for Troubleshooting unit **294084**
18 Push-button ▲
19 Push-button ▼
20 HMENU selection push-button
21 Troubleshooting unit **294084**
22 Speed sensor
23 Engine revs counter (alternator)
24 Transmission oil temperature sensor
25 Driving seat safety switch
26 Safety pressure switch B
27 Safety pressure switch A
28 Range status sensor switch (R2)
29 Range status sensor switch (R1)
30 Gear status sensor switch
31 Parking brake ON switch
32 LOW speed control push-button
33 HIGH speed control push-button
34 Shuttle lever in reverse gear selection position
35 Shuttle lever in forward gear selection position
36 Clutch pedal potentiometer signal
37 Sensor power supply (+5V)
38 Emergency cable for “limp home” after electrics breakdown
39 Battery

POWER SHUTTLE (24 + 24) ELECTRONIC CONTROL UNIT INPUT/OUTPUT CIRCUIT - DIAGRAM W



MPD3139A

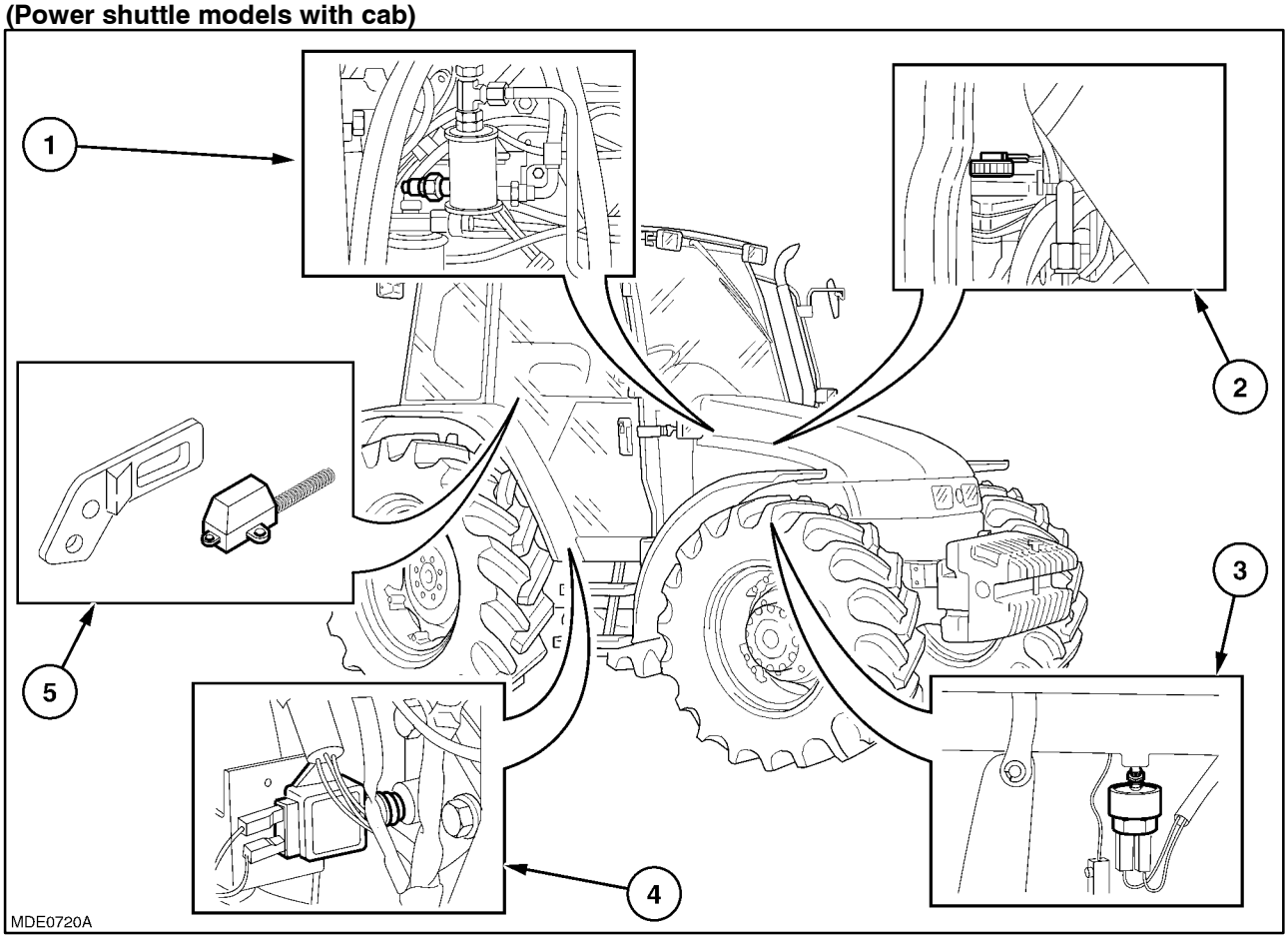
SECTION 55 - ELECTRICAL SYSTEM

Chapter 7 - Components Testing

CONTENTS

Operation	Description	Page
	Low transmission oil pressure switch (83)	2
	Brake fluid level switch (18)	2
	Air filter clogged switch (12)	2
	Differential lock indicator switch (66)	2
	Lift status switch (127)	2
	Italia version trailer brake valve pressure switches (54)	4
	Brake light switch (16)	4
	Engine coolant temperature sensor (2)	4
	Fuel sediment filter switch (4)	4
	Handbrake switch (25)	6
	Dual Command (2 Speed Power Shift) switch (19)	6
	Gear/Range lever position sensors (139-140-141)	6
	Parking switch (147)	6
	Engine oil pressure sensor (82)	9
	Switch (126) and clutch pedal potentiometer (129)	9
	Speed sensors (68-142)	9
	Clutch pressure switches A and B (132-133) and oil temperature sensor (138)	9
	Alternator (87)	9
	Radar (123)	13
	4WD pressure switch (70)	13
	Fuel level indicator (67)	13
	Power Shuttle lever (130)	13
	Electronic lift arm position potentiometer (145)	15
	Seat safety switch (97)	15
	Draft pin sensors (119-120)	15
	PTO speed sensor (62)	15
55 518 52	Front wiper motor. R.I.	17

COMPONENTS
(Power shuttle models with cab)



1

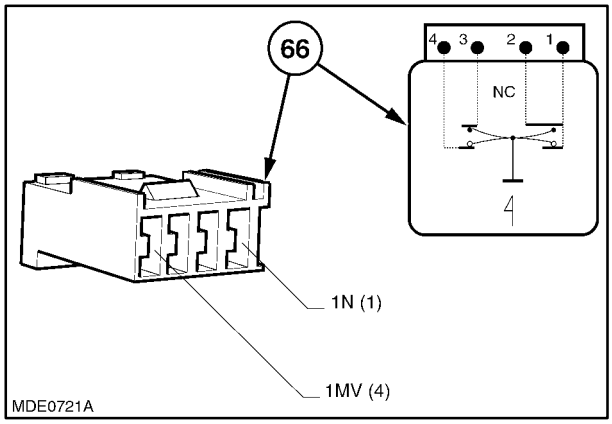
1. Low transmission oil pressure switch (83).
2. Brake fluid level switch (18).
3. Air filter clogged switch (12).
4. Differential lock indicator switch (66).
5. Lift status switch (127).

Differential lock indicator switch (66)

Switch normally off (PIN 1-4).

When the differential lock is engaged, PIN 1-4 closes and grounds PIN 2 of connection (22B) through PIN 23 of connection (79).

The differential lock indicator lights up.



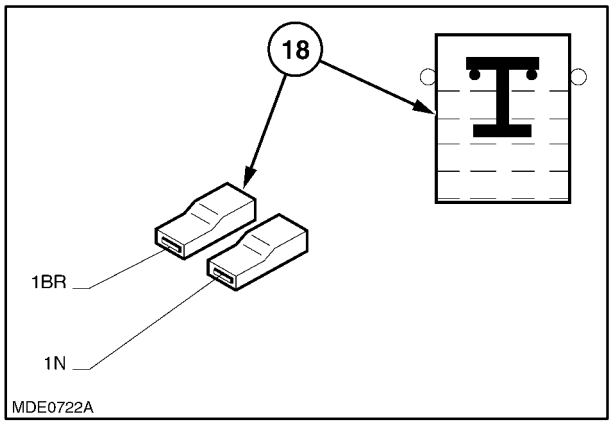
2

Brake fluid level switch (18)

Switch normally on.

When the fluid level is regular, the switch is off.

When the fluid level is below the minimum, PIN 6 of connection (22B) is grounded through PIN B of connection (50) and the indicator lights up.



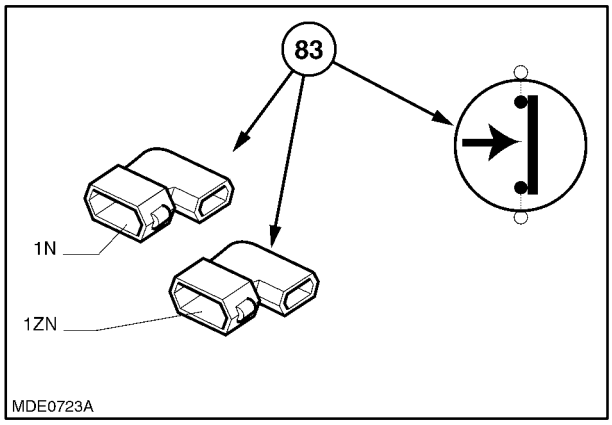
3

Low transmission oil pressure switch (83)

Switch normally on.

Opens with pressure above 159.54 psi (11 bar).

With lower pressures it closes and PIN 1 of connection (22B) is grounded through PIN D of connection 50 and the indicator lights up.

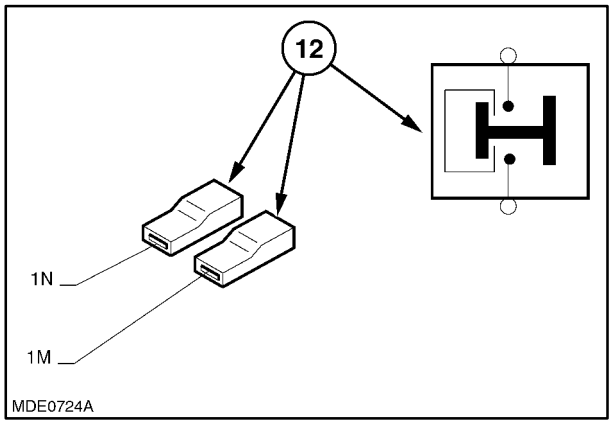


4

Air filter clogged switch (12)

Switch normally off.

When the pressure goes down to 62 mbar, it closes and grounds PIN 11 of connection (22A) through PIN B of connection (50) and the indicator lights up.

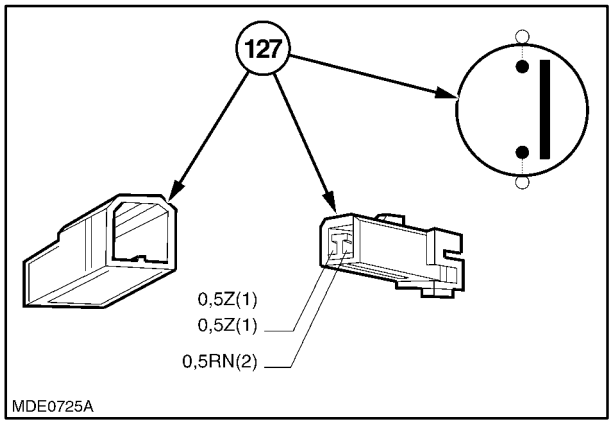


5

Lift status switch (127)

Powered through fuse F20.

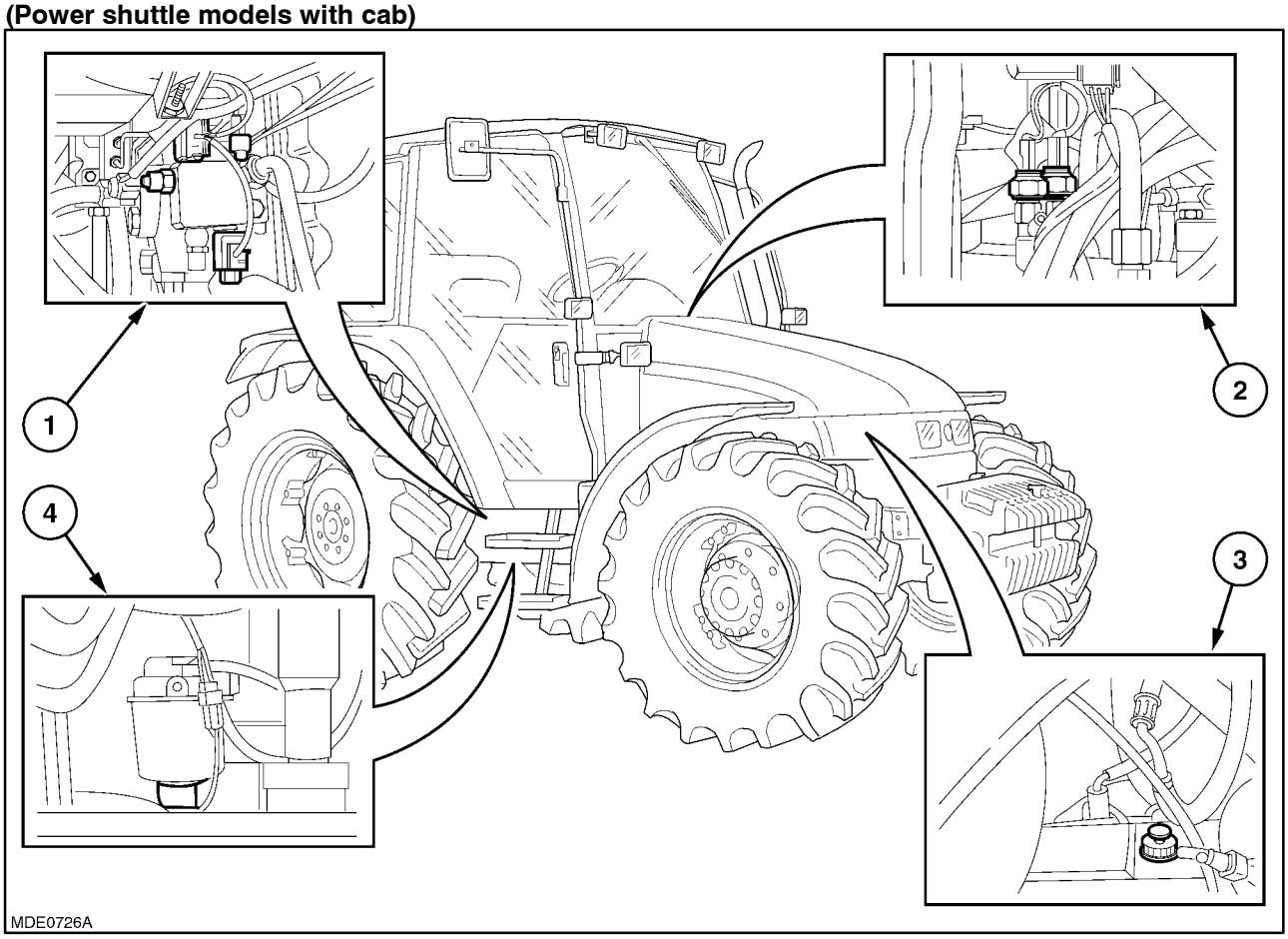
On raising the lift arms with the Lift-O-Matic button, a signal is sent to PIN 6 of connection (30) of the monitor (PHOENIX), to stop the count of the worked area, and to PIN 16 of connection (124) EHC, via PIN 6 of connection (111), to turn off slip control.



6

COMPONENTS

(Power shuttle models with cab)



7

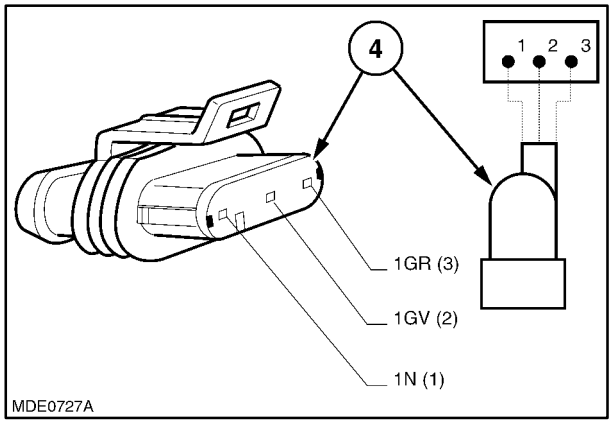
1. Italia version trailer brake valve pressure switches (54).
2. Brake light switch (16).
3. Engine coolant temperature sensor (2).
4. Fuel sediment filter switch (4).

Fuel sediment filter switch (4)

From fuse 16 through PIN N of connection 50 + 12 volt to PIN 2.

PIN 1 to ground.

When water is detected in the circuit, PIN 3 grounds PIN 4 of connection (22A) through PIN M of connection (50) and the indicator lights up.

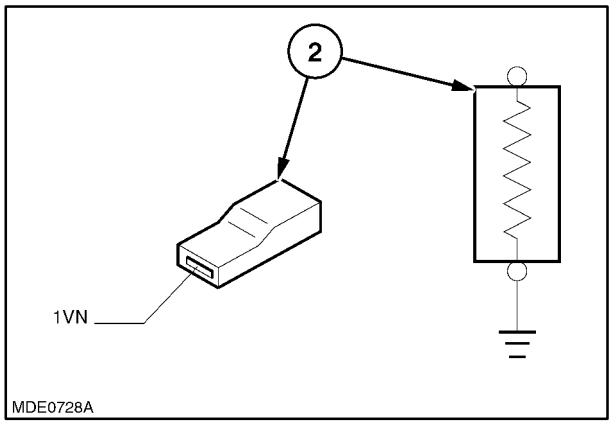


8

Engine coolant temperature sensor (2)

As the temperature varies, the sensor changes its resistance.

Connected to PIN 8 of connection (22B) through PIN J of connection (50).



9

Brake light switch (16)

Switches normally on, they turn off under pressure.

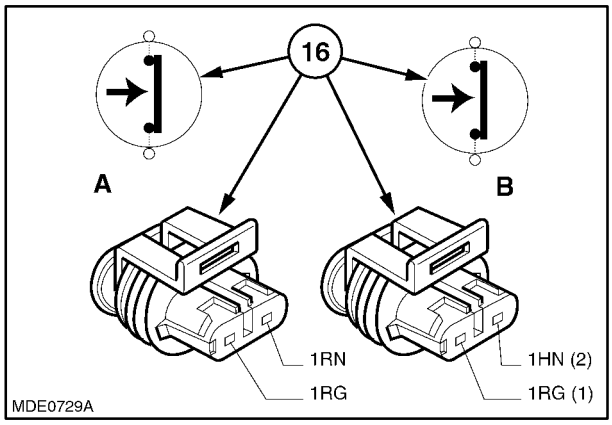
Powered through fuse F17.

A - Sends 12 volts to PIN 86 relay VII.

B - Sends 12 volts to PIN 86 relay X.

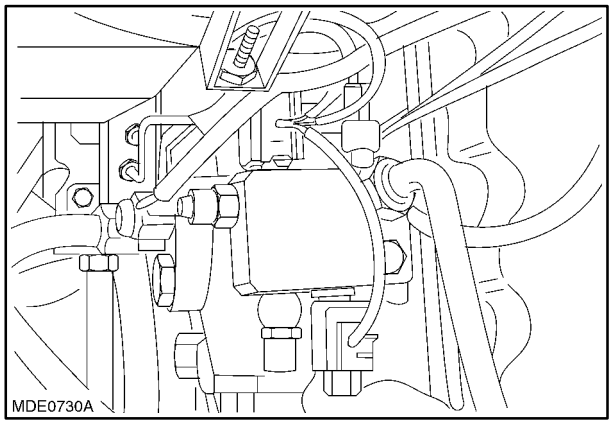
When they are both off, the lock disengages, 4WD engages and the brake lights come on.

When just one is off, the differential lock disengages.



10

Italia version trailer brake valve pressure switches (54)



11

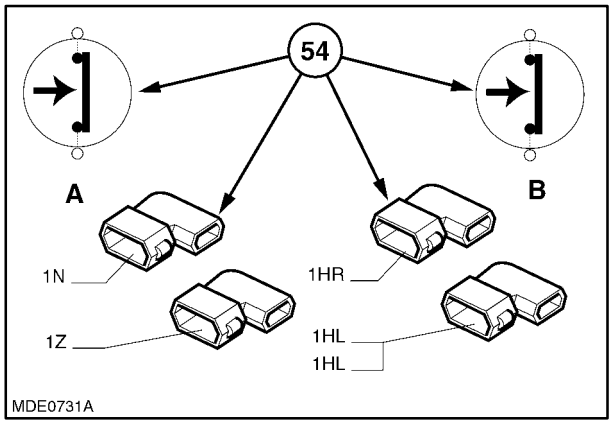
Pressure switches normally on, they turn off under pressure.

A - Turns off at 145.04 psi (10 bar).

When the pressure is lower, it grounds PIN 13 of connection (22B) through PIN 22 of connection (79) and the indicator lights up.

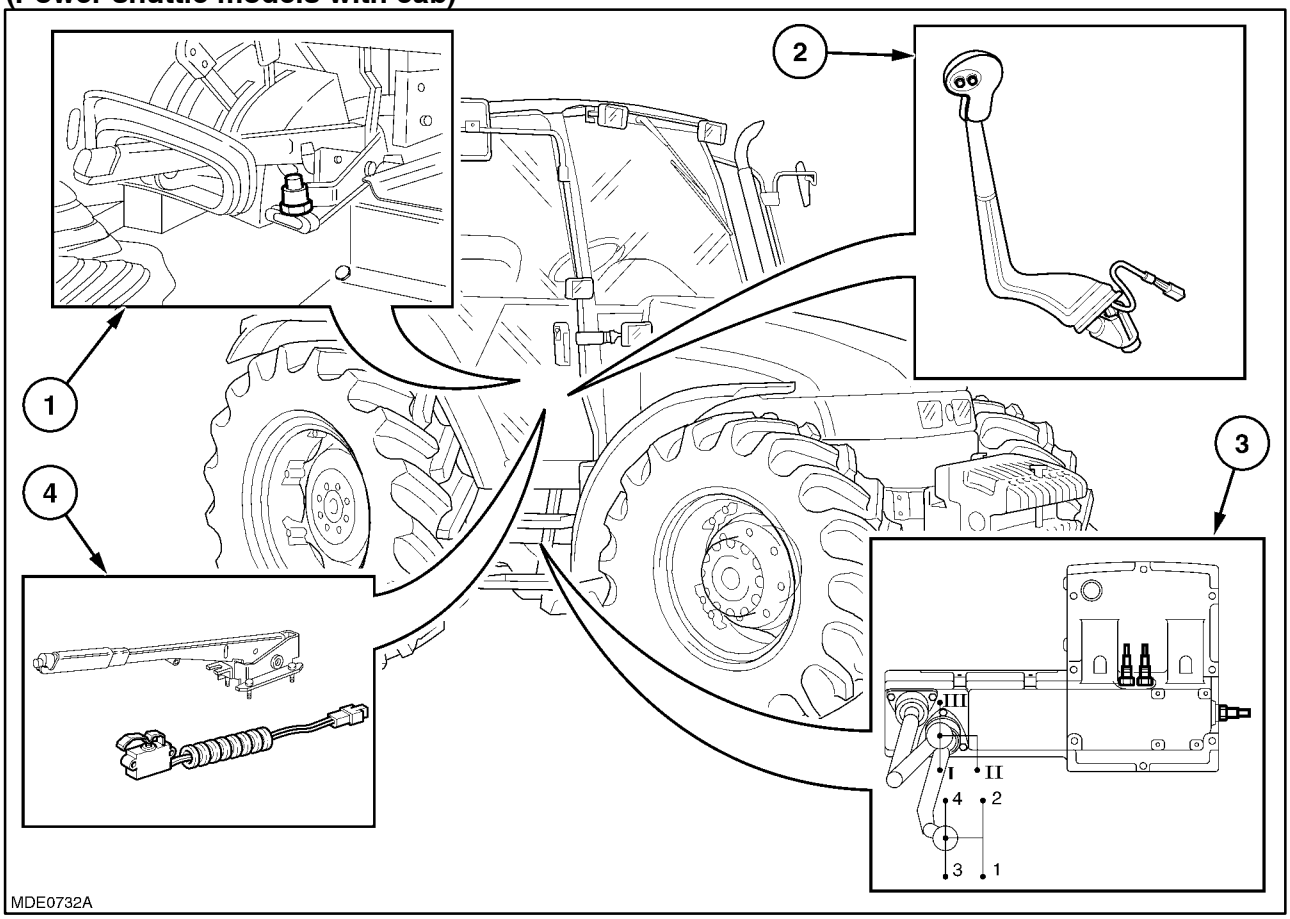
B - Turns off at 50.76 psi (3.5 bar).

When the pressure is lower, it sends +12 volts to PIN 86 of relay H via PIN 18 of connection (79) energizing the two solenoid valves that discharge the 145.04 psi (10 bar) circuit pressure.



12

COMPONENTS
(Power shuttle models with cab)



13

1. Handbrake switch (25).
2. Dual Command (2 Speed Power Shift) switch (19).
3. Gear/Range lever position sensors (139-140-141).
4. Parking switch (147).

Handbrake switch (25)

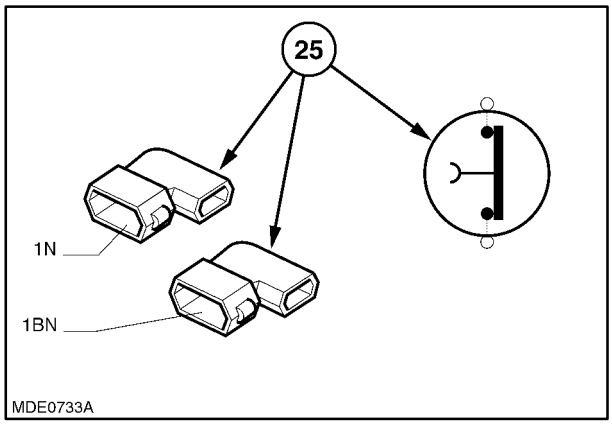
Switch normally on.

Off when the handbrake is disengaged.

When on, it grounds PIN 2 of connection 101 of the safety module circuit, through PIN 3 of connection 99 and grounds PIN 11 of connection (22B) through the diode (107), the indicator lights up.

ITALIA VERSION

When on, it grounds PIN 86 of relay E, energizing the two solenoid valves to discharge the 145.04 psi (10 bar) circuit and mechanically engage the trailer brake.



14

Parking switch (147)

Switch normally off.

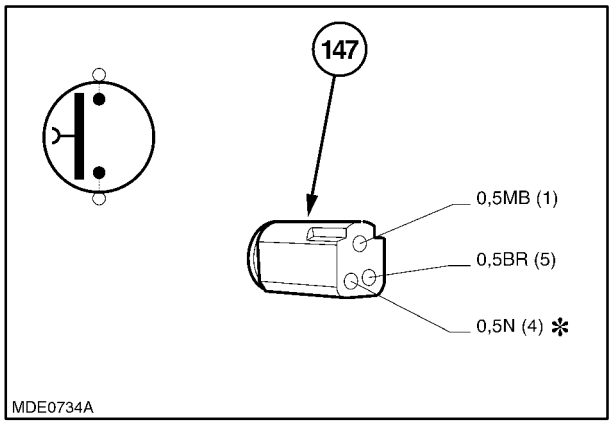
On with handbrake engaged.

+12 volts through SA 10, via fuse F2.

When on, it sends +12 volts to PIN 14 of connection 148 (CN1).

Functional test on H5 d39.

NOTE: * Not used



15

Dual Command (2 Speed Power Shift) switches (19)

Switches normally off.

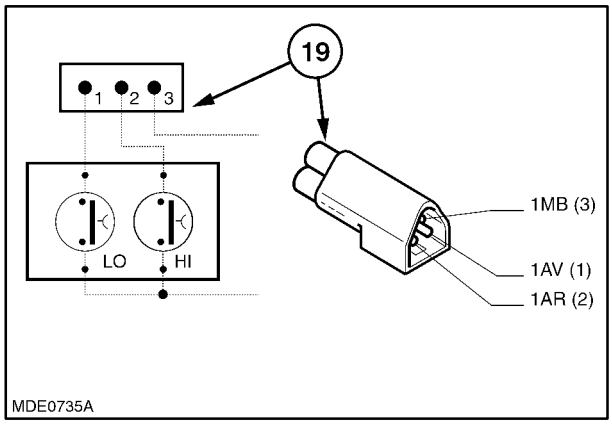
On when a clutch is selected.

+12 volts via fuse F2 through SA 10.

When LOW is pressed, it sends +12 volts to PIN 22 of connection 148 (CN2).

When HIGH is pressed, it sends +12 volts to PIN 3 of connection 148 (CN2).

The control unit engages the selected clutch and grounds PIN 7 of connection 22 B and switches on the LOW indicator light, or PIN 13 of connection 22 A and the HIGH indicator light comes on.



16

Gear/Range lever position sensors (139-140-141)

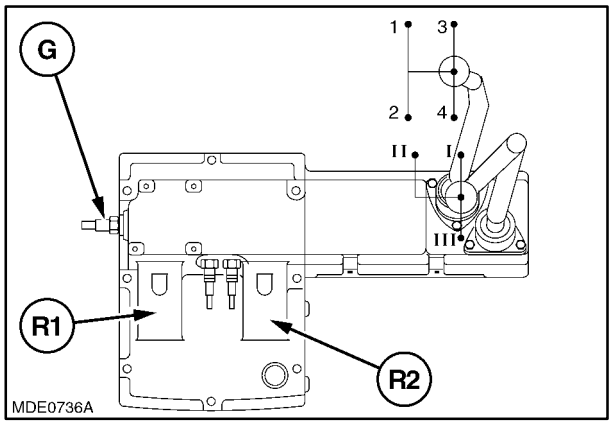
Switches normally off.

+5 volts from PIN 20 of connection 148 (CN2), via PIN 26 of connection 79.

G - sends a signal to PIN 2 of connection 148 (CN2), via PIN 34 of connection 79.

R1 - sends a signal to PIN 23 of connection 148, via PIN 32 of connection 79.

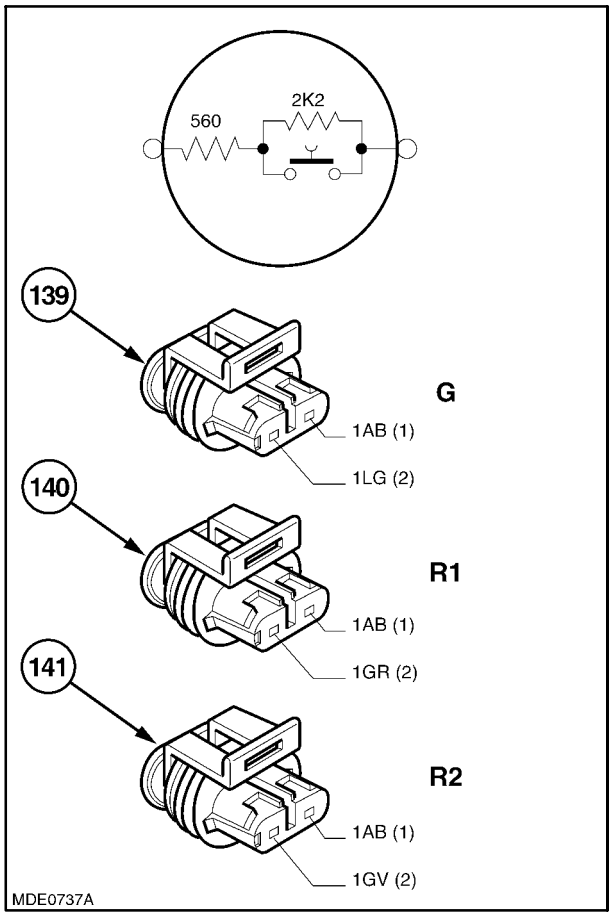
R2 - sends a signal to PIN 21 of connection 148, via PIN 39 of connection 79.



17

Functional test

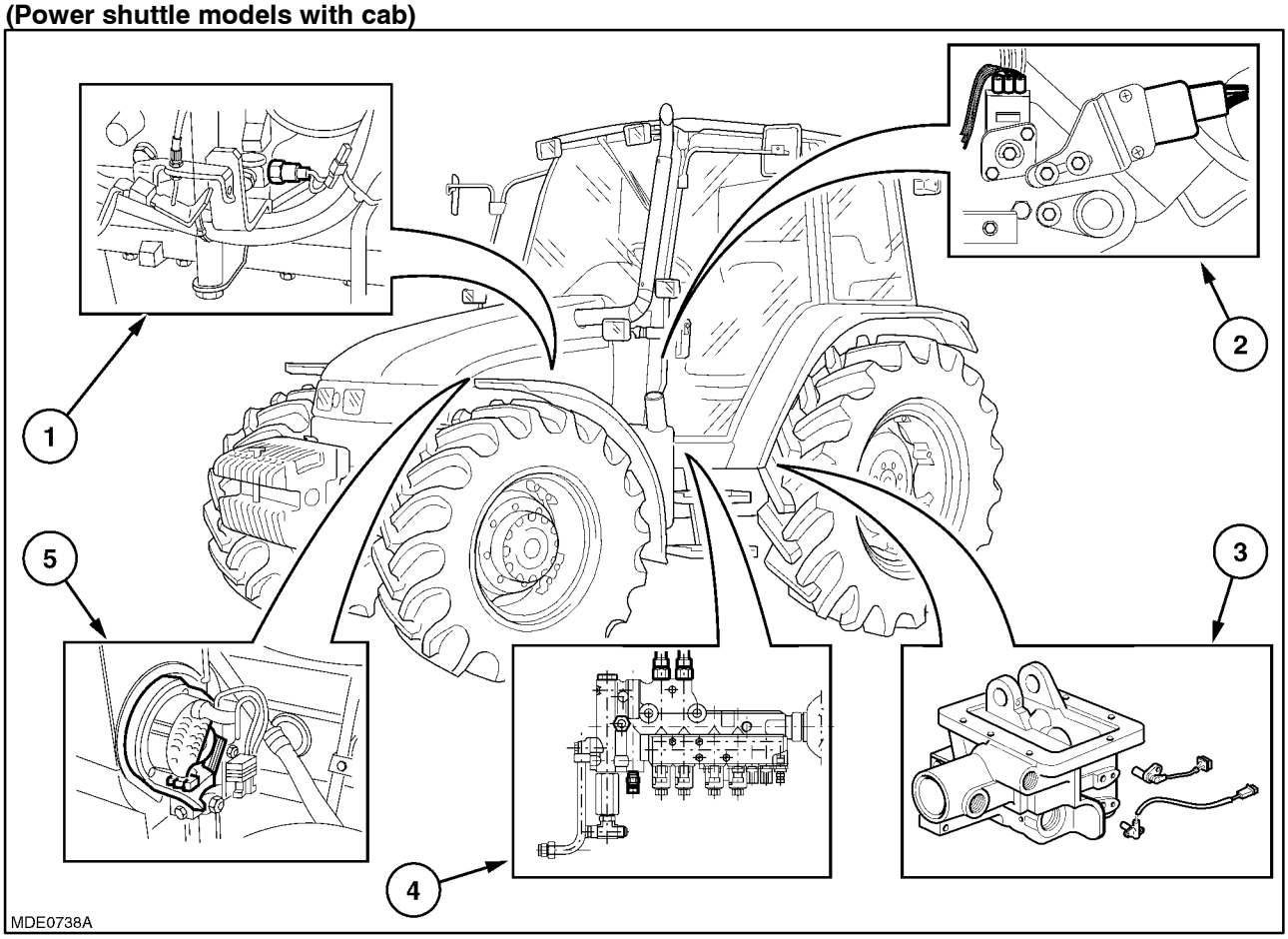
	Gearbox sensor G		
	Status	Ω	Analog-digital conversion H9 (Channel 16)
Neutral	Closed	560	480
1st	Open	2760	170
2nd	Open	2760	170
3rd	Open	2760	170
4th	Open	2760	170



18

	Range sensor R1			Range sensor R2		
	Status	Ω	Analog-digital conversion H9 (Channel 17)	Status	Ω	Analog-digital conversion H9 (Channel 18)
Neutral	Open	2760	170	Open	2760	170
Medium	Open	2760	170	Closed	560	480
Fast	Closed	560	480	Closed	560	480
Slow	Closed	560	480	Open	2760	170

COMPONENTS
(Power shuttle models with cab)



19

1. Engine oil pressure sensor (82).
2. Switch (126) and clutch pedal potentiometer (129).
3. Speed sensors (68-142).
4. Clutch pressure switches A and B (132-133) and oil temperature sensor (138).
5. Alternator (87).

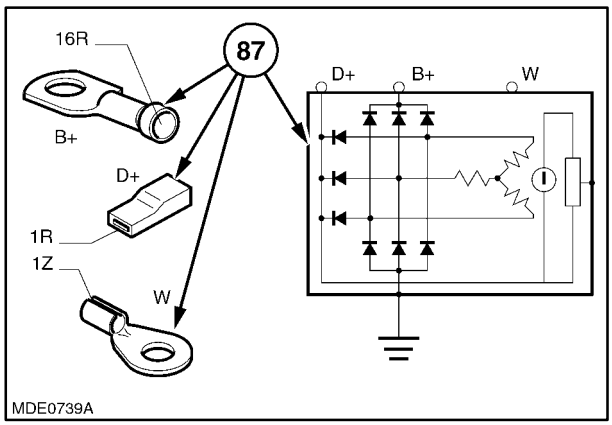
Alternator (87)

B+ battery charging through PIN 30 of the starter motor (84).

D+ +12 volts to PIN 9 of connection (22A) through PIN K of connection (50) to turn off the indicator light.

W signal to PIN 15 of connection 148 (CN2), via PIN G of connection (50).

Functional test in H9 channel 22.

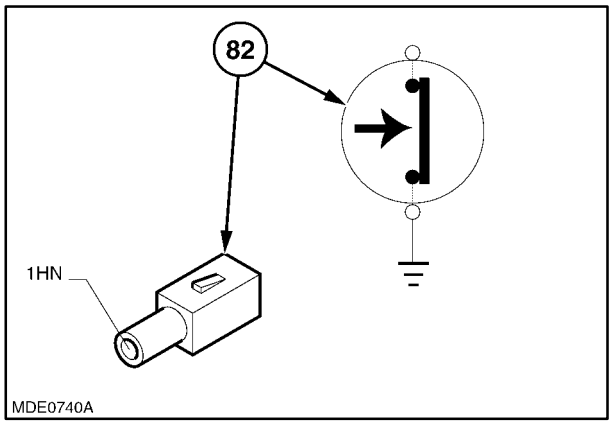


20

Engine oil pressure sensor (82)

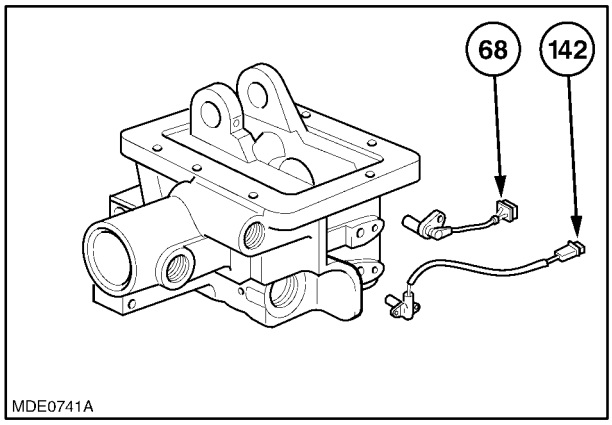
Pressure switch normally on, turns off with a pressure greater than 9.86 psi (0.68 bar).

When turned on it grounds PIN 2 of connection (22A) through PIN A of connection (50) and the indicator light comes on.



21

Speed sensors (68 - 142)



22

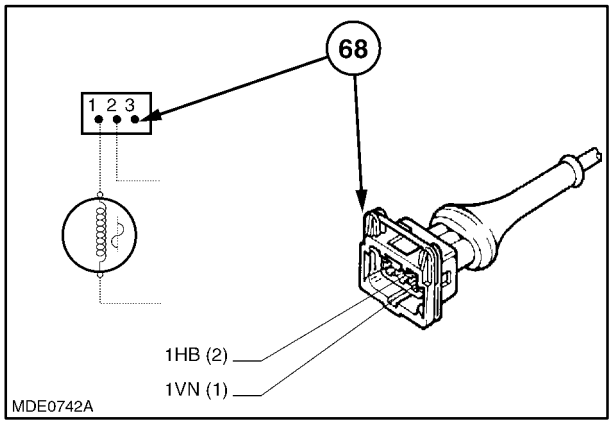
Speed sensor (68)

Speed sensor for electronic lift and performance monitor (PHENIX).

Signal to PIN 1 of connection (111) of the lift and to PIN 1 of connection (36) of the monitor via PIN 8 of connection 79.

Ground through PIN 4 - PIN 2 of connection (111) and PIN 7 of connection (79).

When a mechanical lift is installed, bridge PIN 2 and PIN 4 of connection (111).



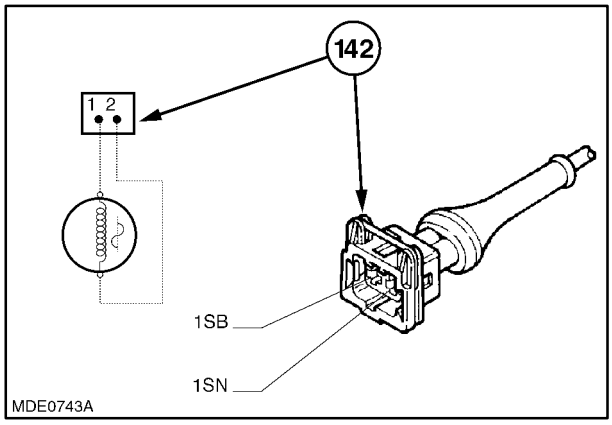
23

Speed sensor (142)

Gearbox control unit speed sensor.

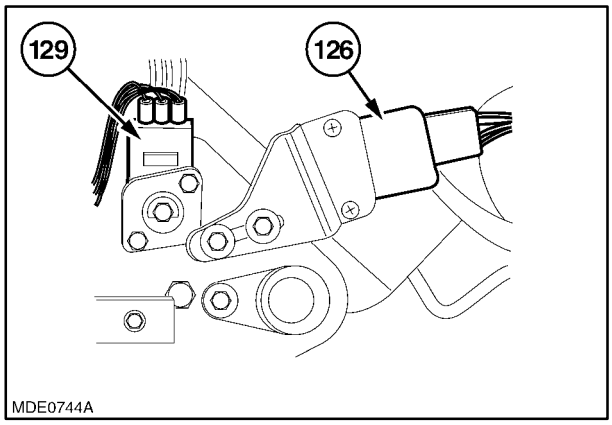
Signal to PIN 36 of connection (148) CN2 through PIN 33 of connection (79).

Ground from PIN 29 of connection (148) CN2 via PIN 25 of connection (79).



24

Switch (126) and clutch pedal potentiometer (129)



25

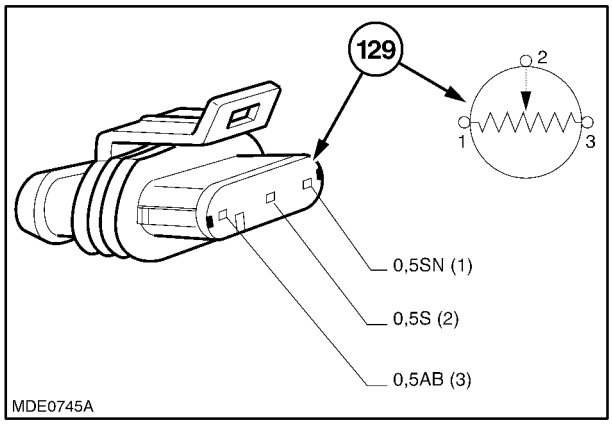
Clutch pedal potentiometer to make gradual movements (129).

PIN 1: ground from PIN 29 of connection 148 (CN2).

PIN 2: signal to PIN 24 of connection 148 (CN2).

PIN 3: +5 volts from PIN 20 of connection 148 (CN2).

Functional test in H9 channel 1.



26

Switch (126)
With clutch pedal pressed.

PIN 4 +12 volts from fuse 23.

PIN 2 +12 volts from PIN 1 SHUTTLE lever (safety on starting) and PIN 18 of connection 148 (CN2) neutral line.

With clutch pedal released.

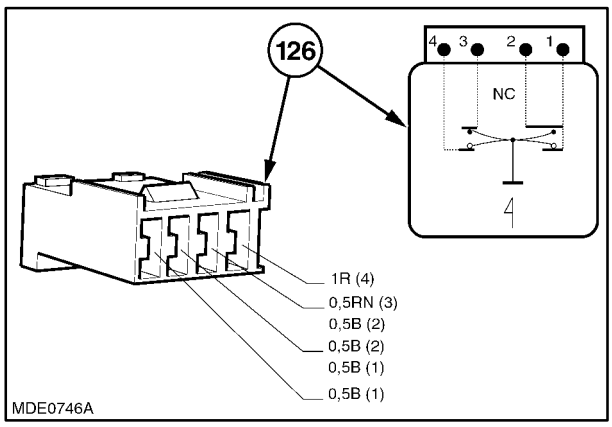
PIN 1 +12 volts from fuse F1 via PIN 3 of the SHUTTLE lever forwards or backwards.

PIN 3 +12 volts to PIN 15 (12 VD) of connection 148 (CN1).

Functional test in H9 channel 4 with SHUTTLE lever forwards or backwards.

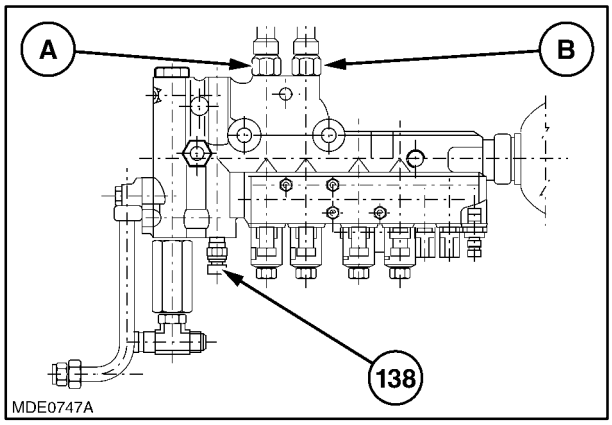
In H5 d21 with SHUTTLE forwards or backwards.

HA adjustment of switch position.



27

POWER SHUTTLE A/B CLUTCH PRESSURE Switches (132-133) and oil temperature sensor (138).



28

Switches (132 - 133).

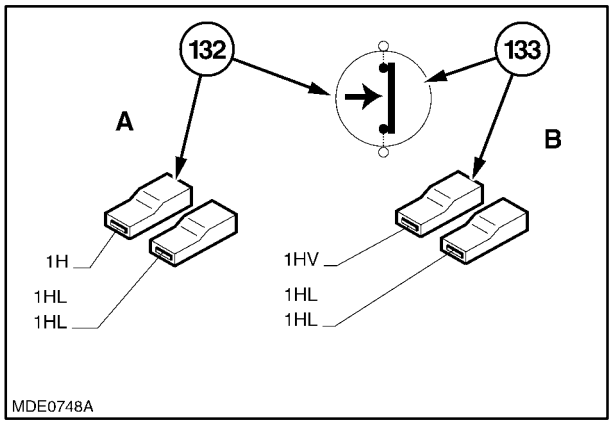
Pressure switches normally on, they turn off with pressure.

+12 volts from fuse 12 via PIN 12 of connection 79.

A - Provides +12 volts on PIN 17 of connection 148 (CN2) via PIN 27 of connection 79.

B - Provides +12 volts on PIN 32 of connection 148 (CN2) via PIN 28 of connection 79.

Functional test in H5 d42 (A) and d43 (B).



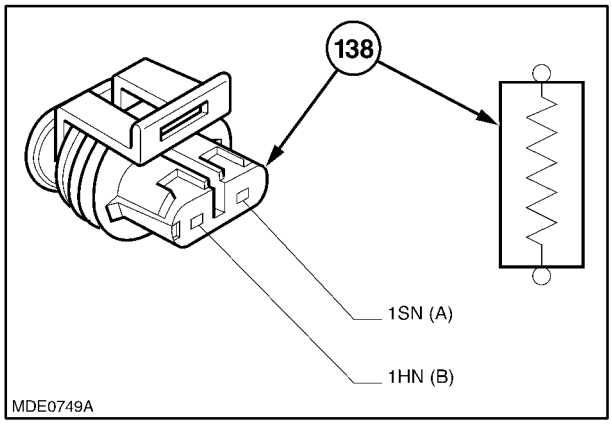
29

Oil temperature sensor (138)

Variable resistance according to temperature.

- Ground from PIN 29 of connection 148 (CN2) via PIN 29 of connection 79.
- Signal to PIN 25 of connection 148 (CN2) via PIN 30 of connection 79.

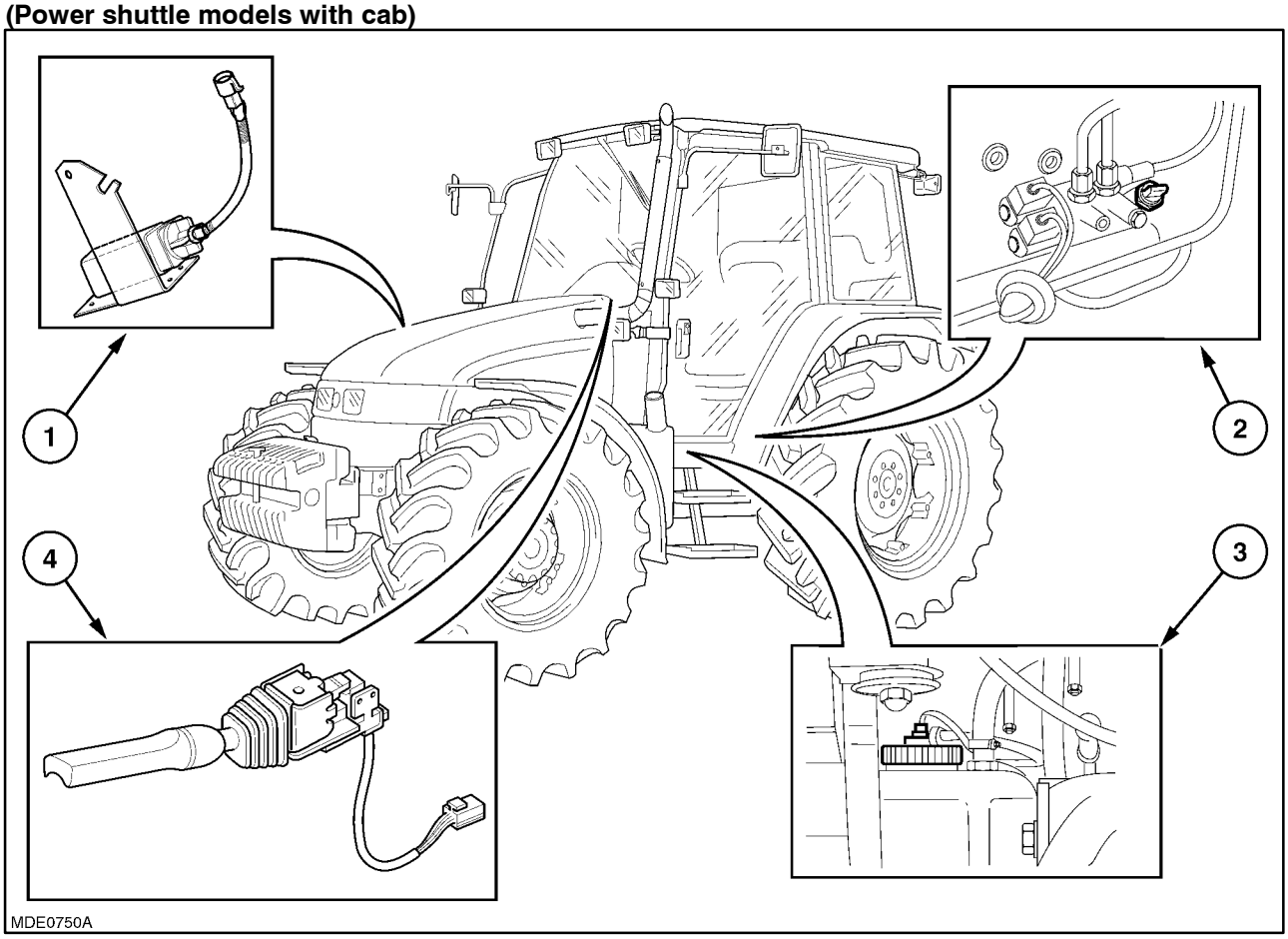
Functional test in H5 d29 and H9 channel 2.



30

COMPONENTS

(Power shuttle models with cab)



31

1. Radar (123).
2. 4WD pressure switch (70).
3. Fuel level indicator (67).
4. Power Shuttle lever (130).

Power Shuttle lever (130)

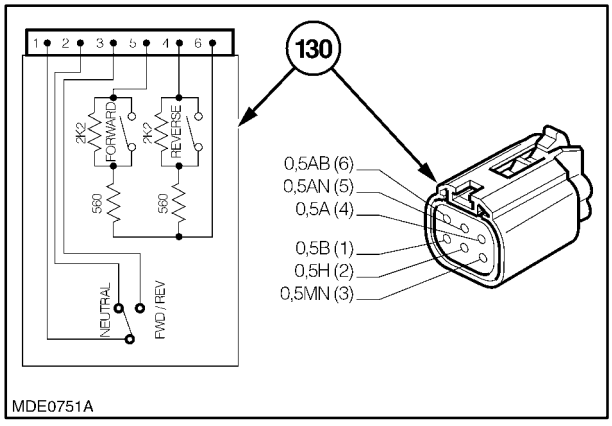
Shuttle lever on neutral:

PIN 1 +12 volts from PIN 2 of the clutch pedal switch (126). PIN 2 +12 volts at PIN 86 relay I (starting safety).

Shuttle lever not in neutral:

PIN 3 +12 volts from fuse F1. PIN 1 +12 volts at PIN 1 of the pedal switch (126) (12VD). PIN 6 +5 volts from PIN 20 of connection 148 (CN2).

- Forwards from PIN 5 signal to PIN 26 of connection 148 (CN2).
- Backwards from PIN 4 signal to PIN 27 of connection 148 (CN2).



32

	Lever position	Status	Ω pin 6-5	* H9 (Channel 9)
For-ward	Forward	Closed	560	480
	Backward	Open	2760	170
Back-ward	Forward	Open	2760	170
	Backward	Closed	560	480
	Lever position	Status	Ω pin 6-4	* H9 (Channel 10)

*Analog-digital conversion

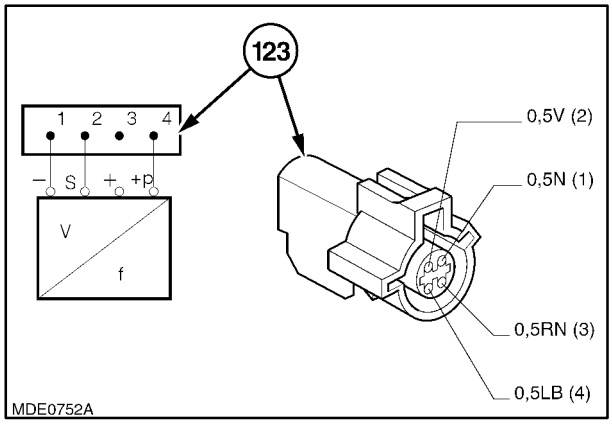
Radar (123)

PIN 1, ground from PIN 16 of connection 111.

PIN 2, signal to PIN 10 of connection 124 and to PIN 8 of connection 111.

PIN 3, +12 volts from fuse 14 via PIN 5 of connection 111.

PIN 4, +12 volts presence signal to PIN 9 of connection 111.

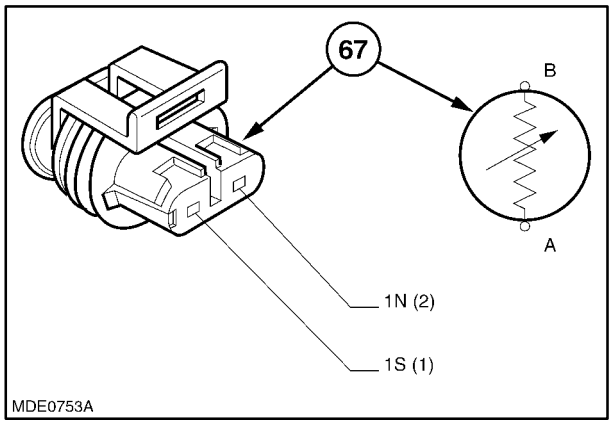


33

Fuel level indicator (67)

PIN A, to ground.

PIN B, signal to PIN 16 of connection 22A via PIN 20 of connection 79.



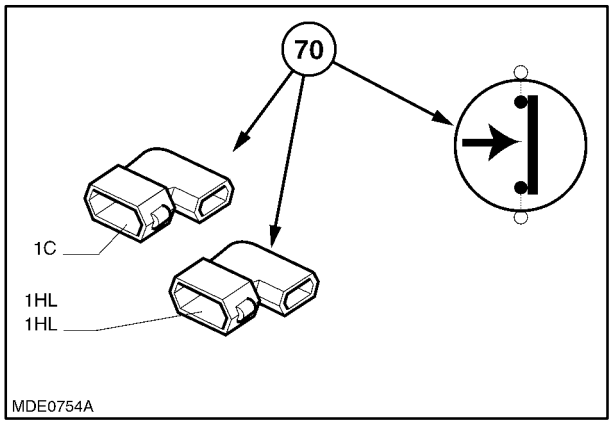
34

4WD pressure switch (70)

Pressure switch normally on; it turns off when 4WD is disengaged.

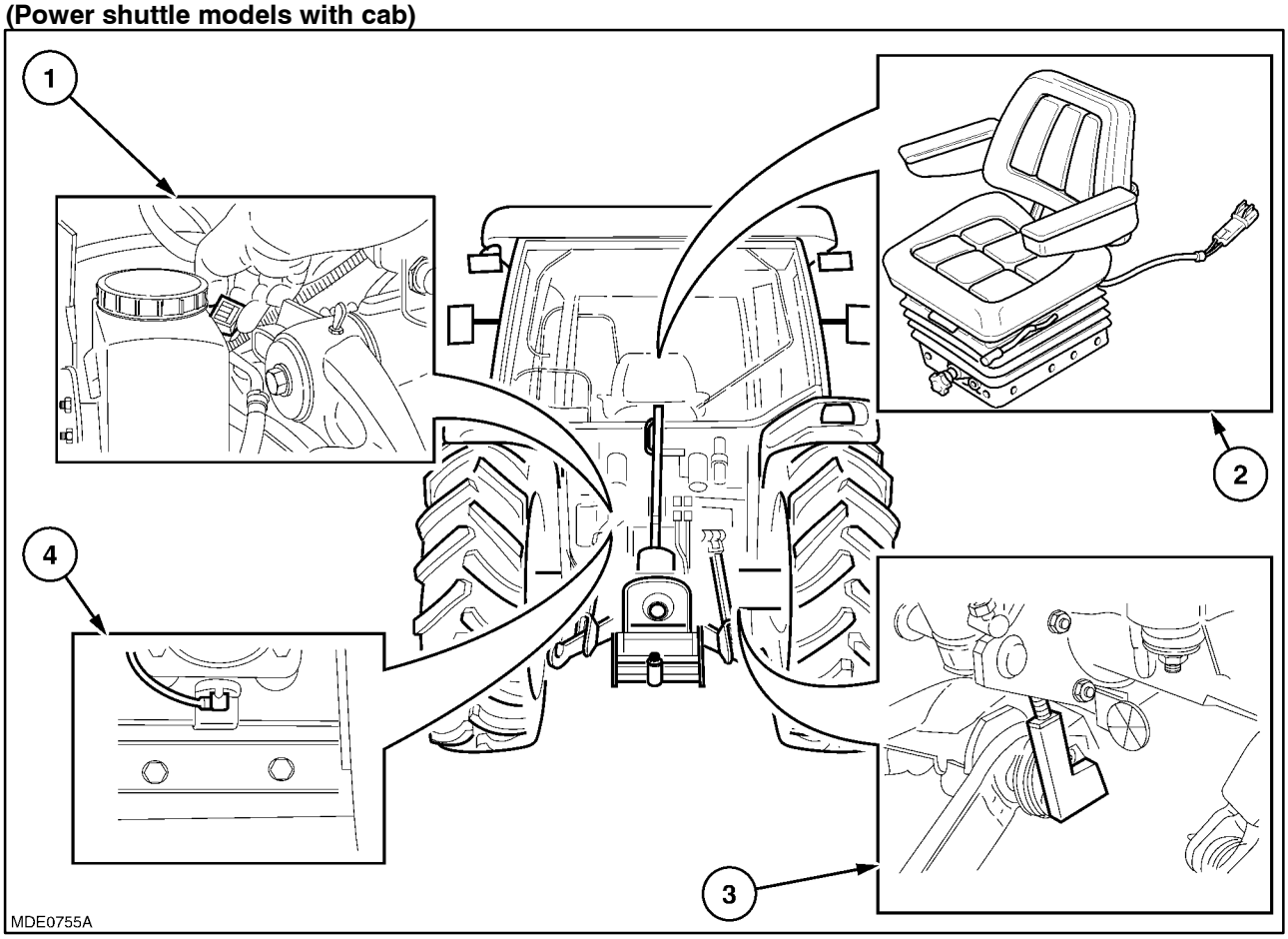
+12 volts from fuse F12, via PIN 12 of connection 79.

When on, it sends +12 volts to PIN 5 of connection 22B via PIN 21 of connection 79.



35

COMPONENTS
(Power shuttle models with cab)

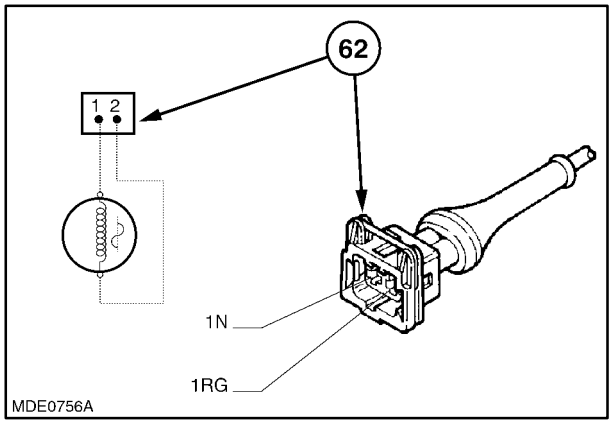


36

1. Electronic lift arm position potentiometer (145).
2. Seat safety switch (97).
3. Draft pin sensors (119-120).
4. PTO speed sensor (62).

PTO speed sensor (62).

Signal to PIN 4 of connection 30 of the monitor (PHOENIX).



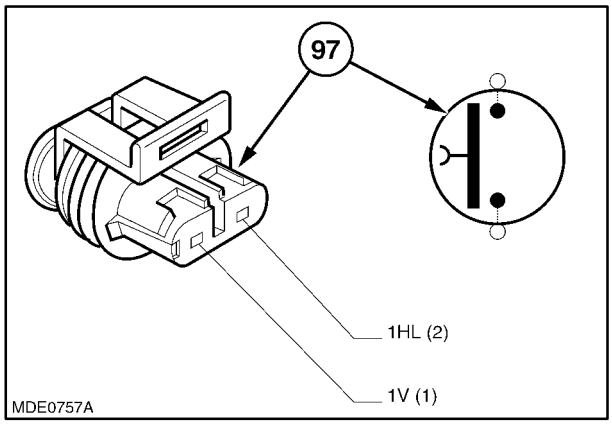
37

Seat safety switch (97)

Switch normally off, on with operator seated.

+12 volts from fuse F12 via SA7.

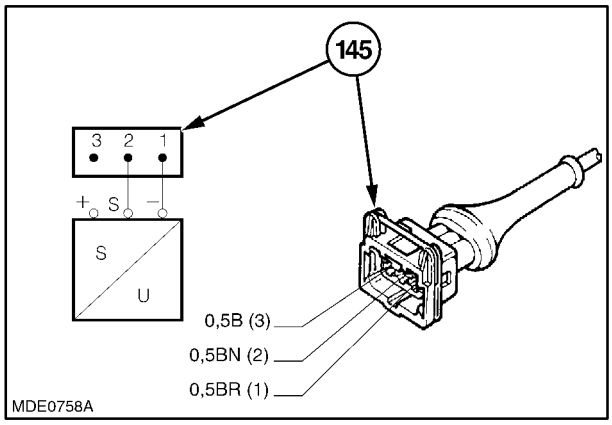
When on, it sends +12 volts to PIN 8 of connection 99 (operator safety circuit) and to PIN 19 of connection 148 (CN2).



38

Electronic lift arm position potentiometer (145).

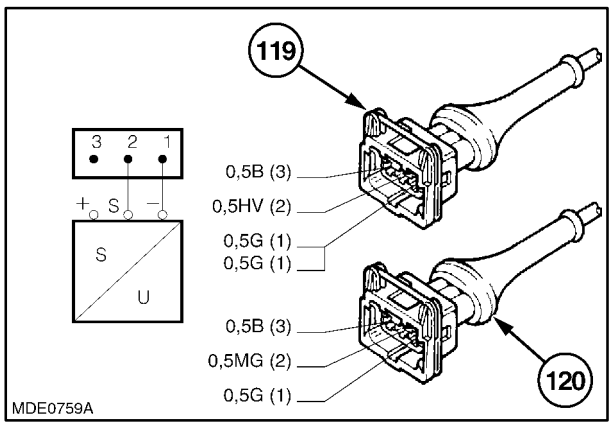
- PIN 1 ground from PIN 38 of connection 124 via PIN E of connection 118.
- PIN 2 signal to PIN 6 of connection 124 via PIN B of connection 118.
- PIN 3 +8.5 volts from PIN 39 of connection 124, via PIN J of connection 118.



39

Draft pin sensors (119 - 120)

- PIN 1: ground from PIN 1 of connection 124 via PIN A of connection 118.
- PIN 2: signal
- RH (119) to PIN 26 of connection 124 via PIN G of connection 118.
- LH (120) to PIN 7 of connection 124 via PIN C of connection 118.
- PIN 3 +8.5 volts from PIN 39 of connection 124, via PIN J of connection 118.



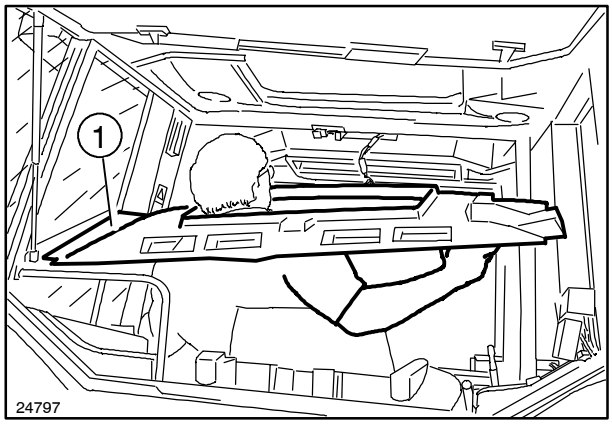
40

Op. 55 518 52
FRONT WIPER
MOTOR R.I.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Detach **THE CAB CEILING TRIM** from the framework, carrying out the sequences described in operation **90 160 60**.



41

2. Working from the outside of the cab, unhook the hood, unscrew the retaining screws and the windscreen wiper blade.

3. Unscrew the two retaining nuts and the windscreen wiper motor.

4. Refit the wiper motor as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Refit the motor unit and secure it with the two nuts.

- Fit the wiper blade back on.

- Fit the **CAB CEILING TRIM** back onto the framework, carrying out the sequences described in operation **90 160 60**.

SECTION 90 - BODYWORK AND DRIVING POSITION

Chapter 1 - Removal of components

CONTENTS

Operation	Description	Page
90 110 36	Platform. R.I.	2
90 120 10	Driver's seat. R.I.	10
90 154 10	Cab right- or left-hand door. R.I.	11
90 156 10	Cab windscreen. Repl.	12
90 156 14	Cab RH or LH bottom front window. Repl.	12
90 156 52	Cab rear window. Repl.	14
90 160 16	Left-hand upright strip. Repl.	17
90 160 16	Right-hand upright strip. Repl.	18
90 160 42	Fixed padding on right-hand wall. Repl.	22
90 160 43	Fixed padding on left-hand wall. Repl.	28
90 160 50	Hydraulic control lever guard. Repl.	30
90 160 60	Cab ceiling trim. Repl.	32

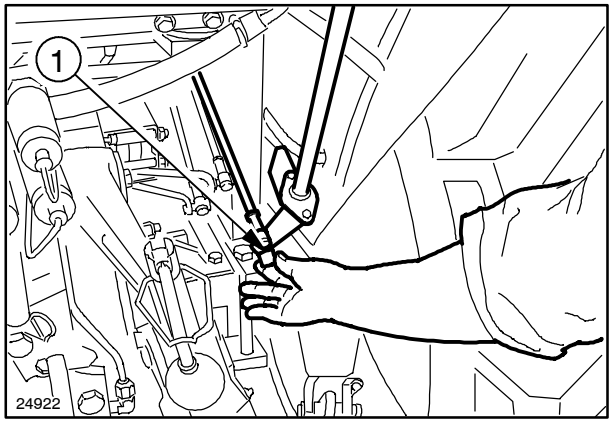
Op. 90 110 36
PLATFORM R.I.

CAUTION

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks. Check that no one is in the vicinity of the load to be lifted.

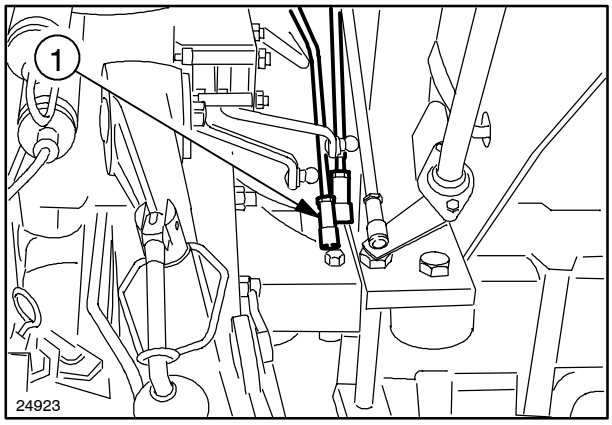
1. Disconnect the battery negative cable.

2. Detach the retaining spring (1) and disconnect the lift ground control drive rod.



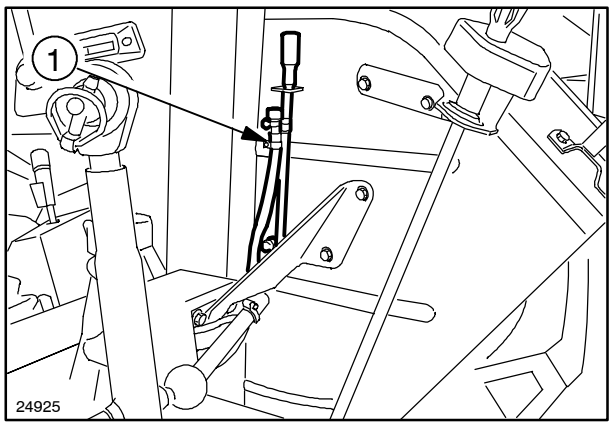
1

3. Remove the retaining springs and detach the two draft and position control rods (1) and, if necessary, also detach from the cab and remove.



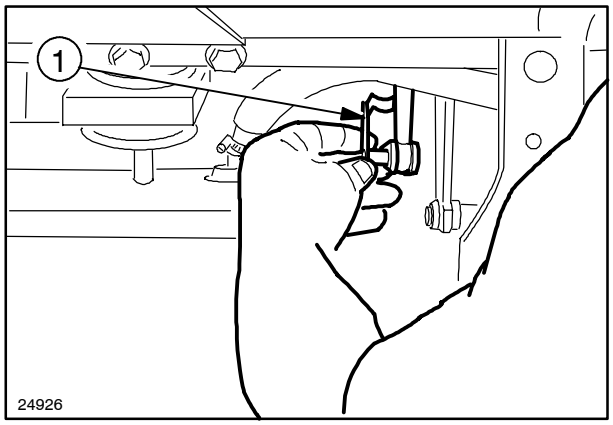
2

4. Unscrew the bolts (1) securing the fuel tank breather pipes and transmission from the mudguard.
5. Detach the control valve rods.



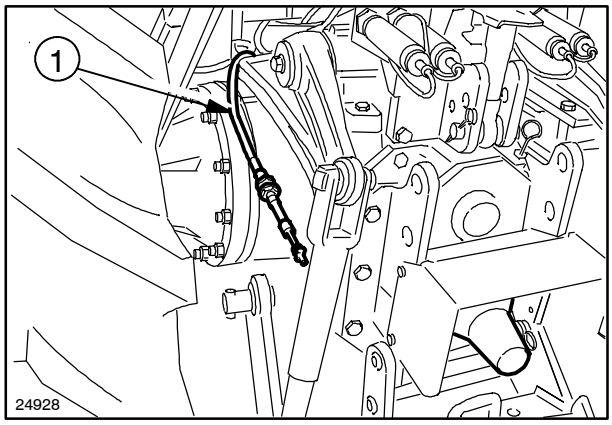
3

6. Detach the retaining springs (1) on the PTO synchronised with gearbox control lever.
7. Disconnect the Creeper engagement lever.



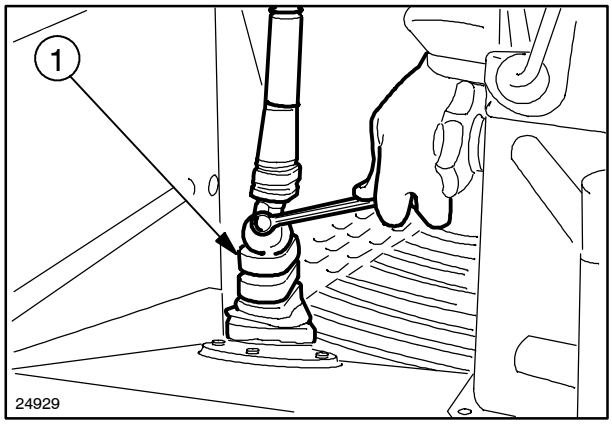
4

8. Detach the PTO speed selection control tie-rod (1).



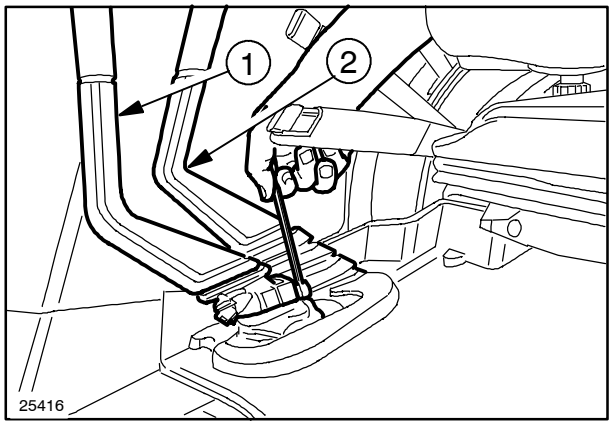
5

9. Slide the dust hood down, unscrew the retaining bolts and detach the reverser control lever (1).



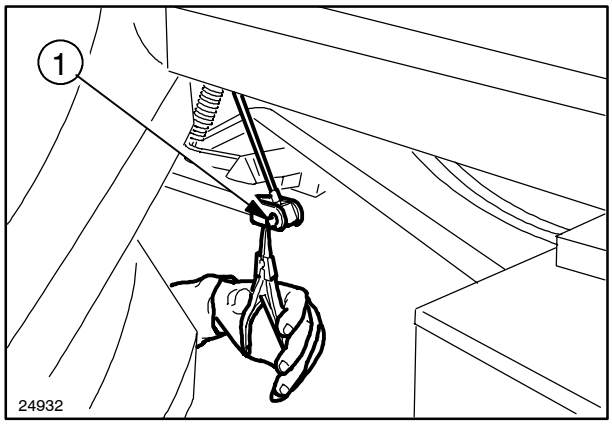
6

10. Lower the dust hood, disconnect the electrical connection on the Dual Command (2 Speed Power Shift), loosen the retaining bolt and detach the gear selection lever (1).
11. Lower the hood, loosen the retaining bolt and remove the range selection lever (2).



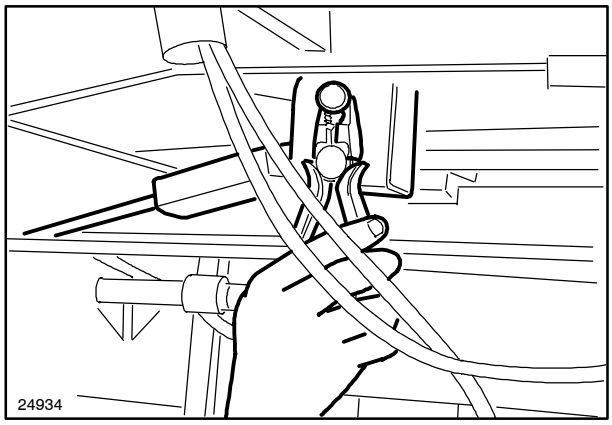
7

12. Remove the snap ring (1), extract the pin and disconnect the parking brake control cable.



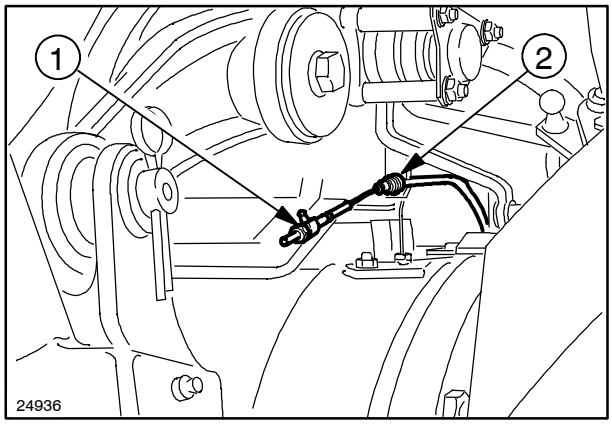
8

13. If a rear mechanical lock is fitted, remove the front and rear split pins and pivot pins, then remove the lever.



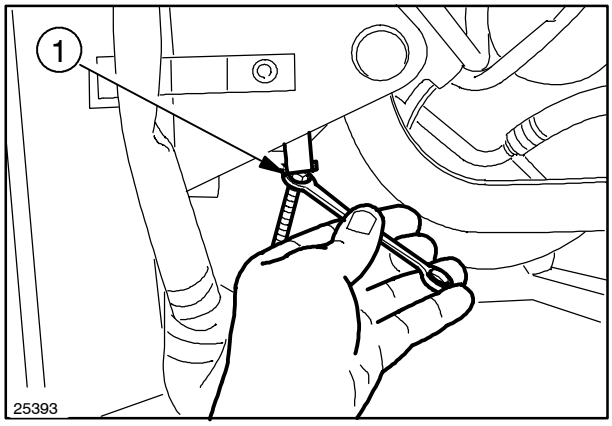
9

14. Detach the Lift-O-Matic control cable (1) from the lever on the lift body and extract from the bracket (2).



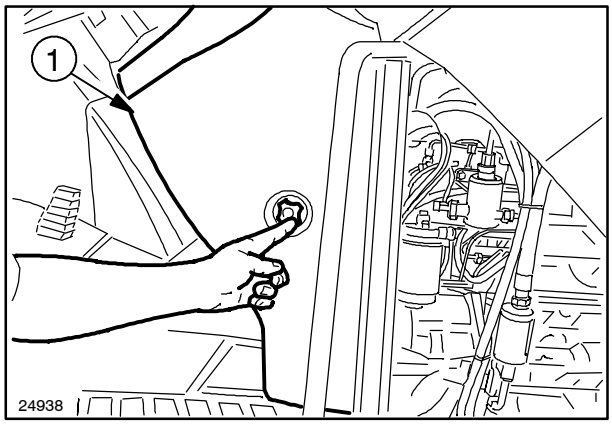
10

15. Remove the knob and the left-hand guard.
16. Unscrew the locknut and detach the clutch tie-rod (1), remove the rubber guard and extract the tie-rod through the relative hole.



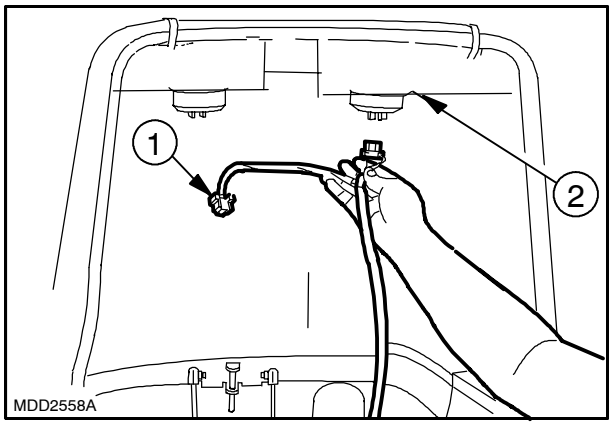
11

17. Unscrew the knobs, the right-hand guard (1) and detach the accelerator pedal cable.



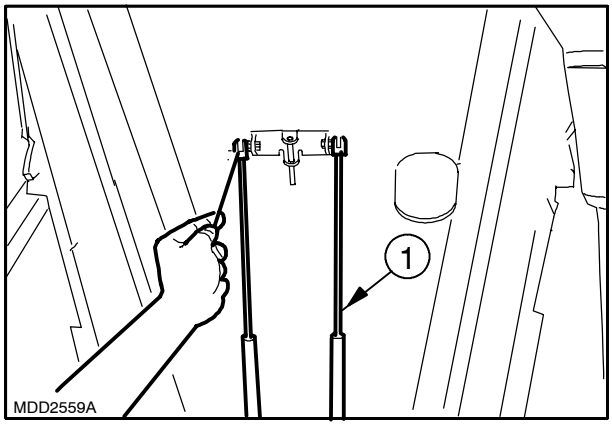
12

18. Remove the exhaust pipe, raise the bonnet and disconnect the front headlight (2) connections (1).



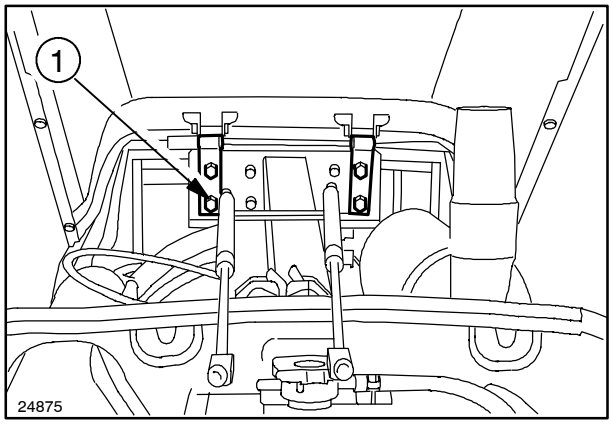
13

19. Detach the gas springs (1) on the bonnet.



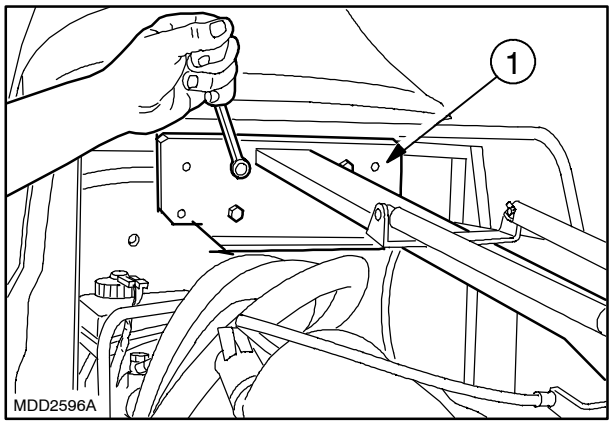
14

20. Unscrew the four pivot bolts (1) and remove the bonnet.



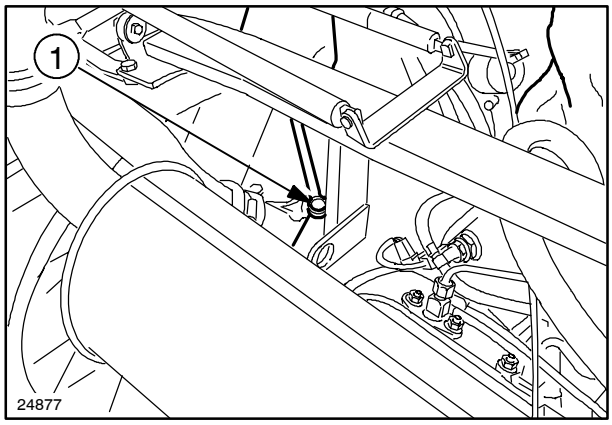
15

21. Remove the bonnet support rear bracket bolts (1).



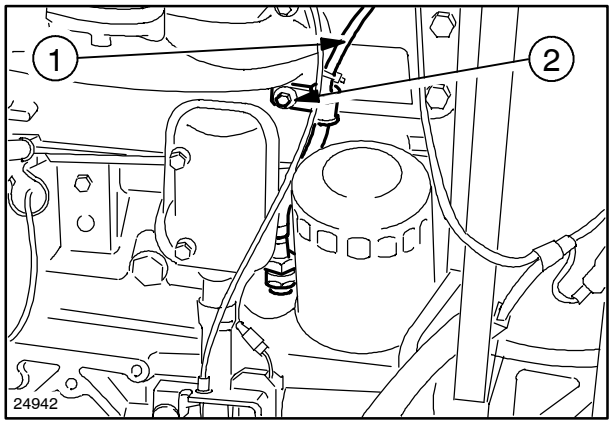
16

22. Remove the bonnet support front bracket bolts (1).
23. Disconnect the main electrical connections.



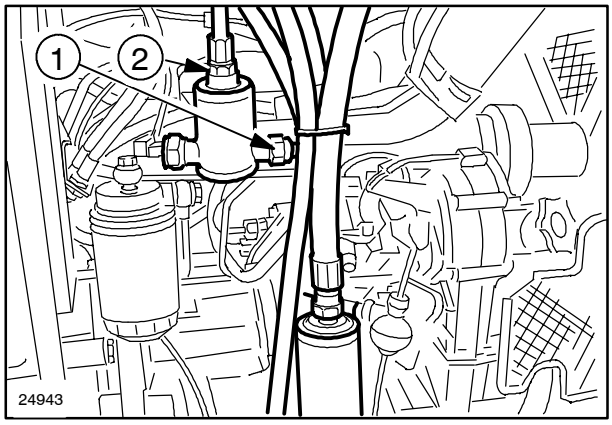
17

24. Disconnect the rev counter (1) cable on the engine and unscrew the bracket retaining bolt (2).



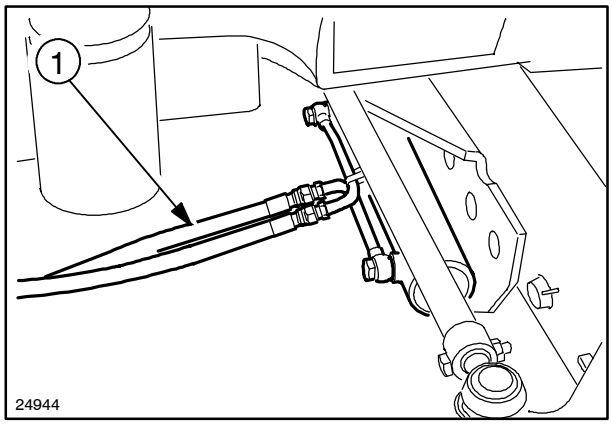
18

25. Disconnect the piping (1 and 2) on the anticavitation tank.



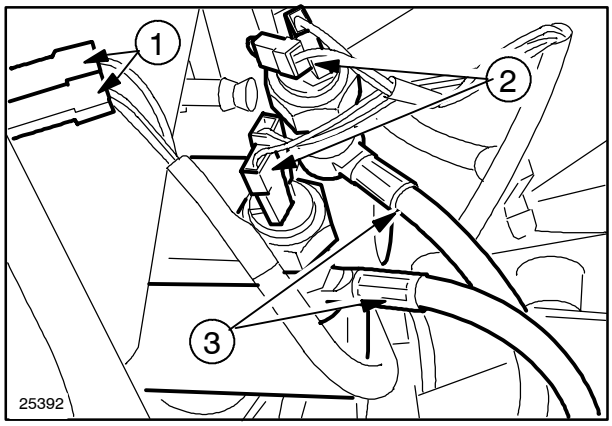
19

26. Detach the two hoses (1) on the power steering control cylinder (mark the hoses to avoid confusion when refitting).



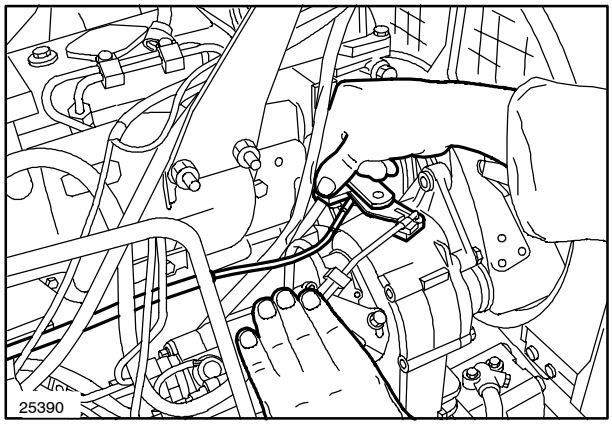
20

27. Disconnect the electrical connections (1 and 2) on the oil reservoir and brake pump.
28. Detach the control lines (3) on the brake pump, removing the pressure gauges.



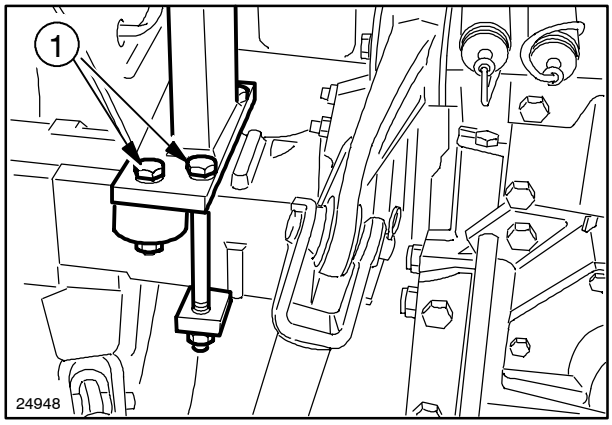
21

29. Disconnect the accelerator cable (1) from the injection pump.



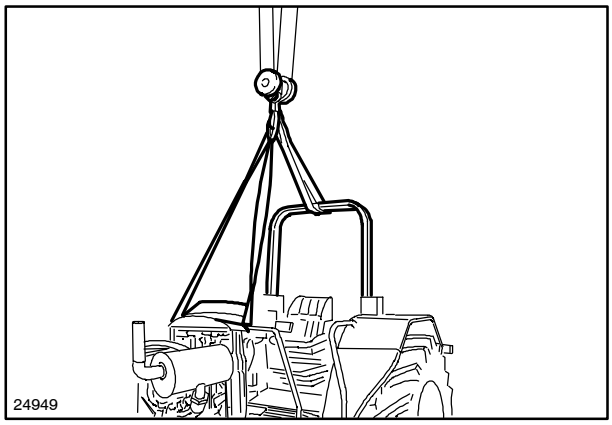
22

30. Unscrew the bolts (1) securing the platform to the final drive (carry out on both sides).



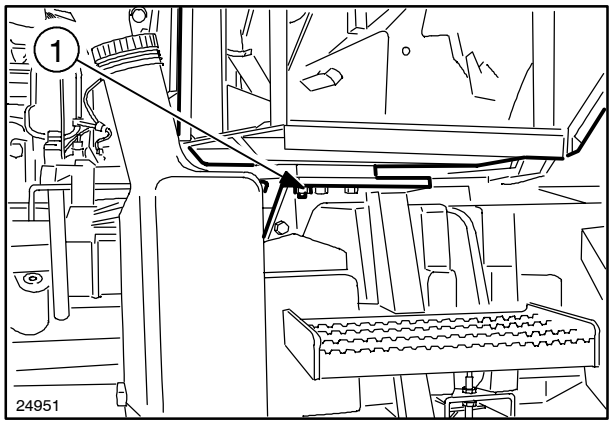
23

31. Hitch the platform to a hoist using 2 nylon slings and take up the slack.



24

32. Unscrew the front bolt (1) securing the platform to the relative support (carry out on both sides).
33. Slightly raise the platform, making sure that there are no obstructions or connected parts, then remove and position on the flooring on a suitable support.



25

34. To refit the platform on the rear transmission-gearbox, proceed as follows.

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

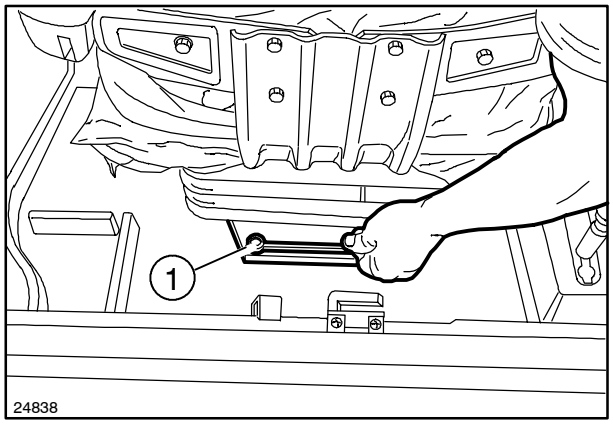
- Insert the longest bolt in the front inside hole (tank side) of the left-hand platform retaining bracket. Using two nylon slings and a hoist, position the platform on the transmission and secure with the retaining bolts.
- Connect the throttle control cable.
- Connect: the service brakes piping to the relative pump and the electrical connections to the brake oil reservoir and pressure gauges.
- Connect the piping on the anticavitation tank.
- Connect the steering cylinder control piping.
- Connect and secure the speedometer/tachometer control cable.
- Connect the electrical connections between the platform and the tractor body.
- Assemble the engine bonnet support bracket and secure in position.
- Assemble the bonnet and gas springs and secure in position.
- Connect the front light connections.
- Connect the clutch-gearbox cable and fit the guards under the control panel.
- Connect the Lift-O-Matic control cable.
- Connect the differential lock mechanical control tie-rod, if fitted.
- Connect the parking brake control cable.
- Assemble the main gear and creeper levers and, if fitted, connect the Dual Command (2 Speed Power Shift) connections.
- Assemble the reverser lever, if fitted.
- Connect the PTO speed selection cable.
- Connect the control levers on the Creeper and PTO synchronised with gearbox.
- Fit the fuel tank and rear transmission-gearbox breather pipes.
- Connect the lift control levers.
- Connect the negative cable to the battery.

Op. 90 120 10
DRIVER'S SEAT R.I.

CAUTION

Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Unscrew the bolts (1) securing the seat to the bodywork and remove the seat.



26

2. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Fit the seat on the platform of the bodywork and lock the retaining bolts (1).

Op. 90 154 10
CAB RIGHT- OR LEFT-HAND DOOR R.I.

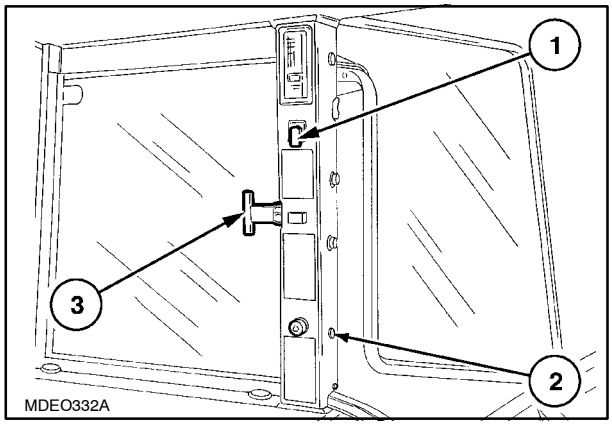
DANGER

Lift and handle all heavy parts using suitable lifting equipment.
Make sure that assemblies or parts are supported by means of suitable slings and hooks.
Check that no one is in the vicinity of the load to be lifted.

To assemble, proceed as follows:

1. Carry out the disassembly sequences described in operations **90 160 16** for the **LH** or **RH** upright strips.

2. Detach the door-closing gas springs.

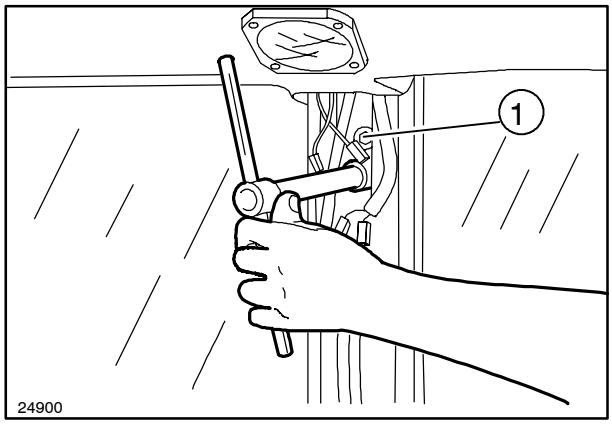


27

3. Working from the inside of the cab, unscrew the two upper screws (1) holding the door hinge in position.

4. Working from the inside of the cab, unscrew the two lower nuts (1) securing the hinge and remove the door.

5. To assemble, proceed as follows:



28

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Fit the left- or right-hand door back on and tighten the retaining nuts.

- Fit the door-closing gas springs back on.

- Carry out the assembly sequences described in operations **90 160 16** for the **LH** or **RH** upright strips.

Op. 90 156 10 - 90 156 14
GLUED CAB WINDOWS
Repl.

Proceed as follows:

⚠ CAUTION ⚠

Handle all parts carefully.

Do not put your hands or fingers between parts.

Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Working from the inside of the cab, push the cutting wire (1, fig. 29) through the adhesive (2) between the window and its surround, using the needle on the tool.

2. Thread the cutting wire (1, fig. 30) into the tool and lock in position.

3. Secure the wire (1) to the handgrip (2).

4. Lock the tool on the adhesive (see fig. A). Keep the wire close to the window and pull on the handgrip (2, fig. 31).
5. Repeat this operation until the window is completely detached. Make long cuts on straight sections and short cuts around corners to prevent the window from breaking.

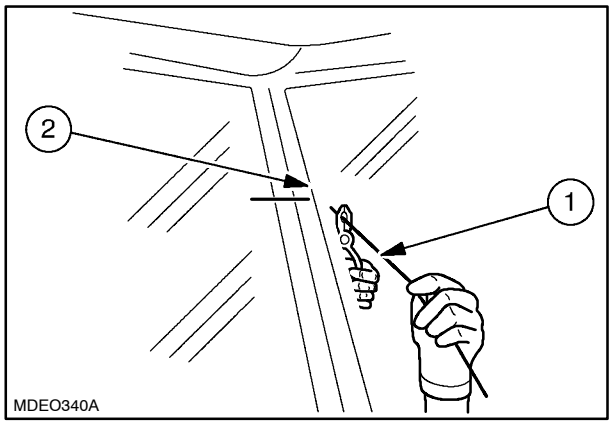
6. Using suction cups, remove the window and place on a flat surface to avoid damage.

7. Using a scraper, thoroughly clean away the adhesive (1, fig. 32) from the contact surfaces with the windscreen, taking care not to cause damage.

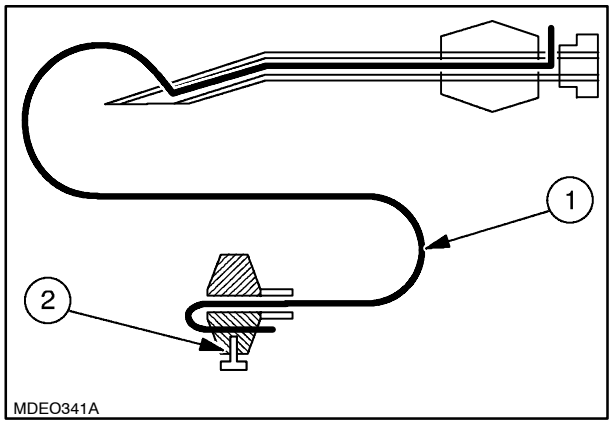
8. Remove the adhesive from the window as described in the previous operation.

NOTE: *When replacing a broken window: remove any fragments still attached to the cab support frame, following only the necessary aforementioned operations.*

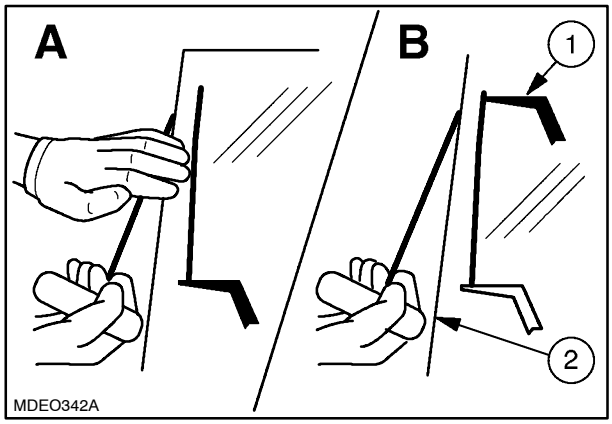
9. Clean the windscreen surround and windscreen using a suitable solvent.



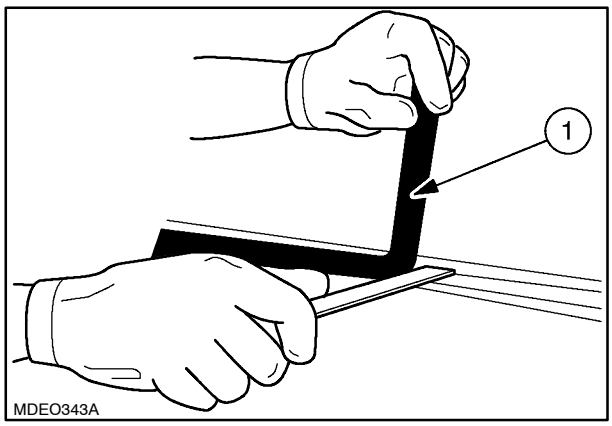
29



30



31



32

Fitting the window

Proceed as follows.

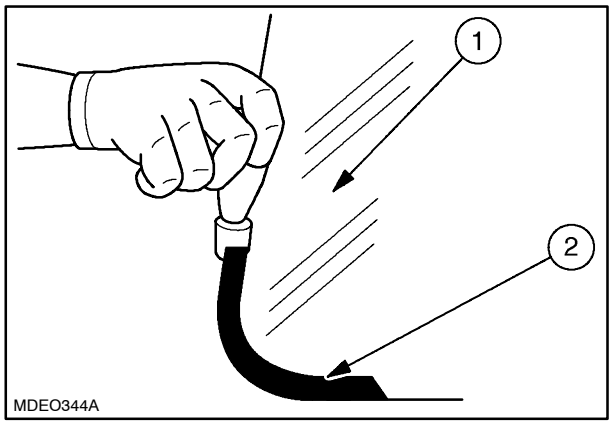
10. Make sure that the contact area between the windscreen and its surround is perfectly clean.

11. Apply the glass activator Betawipe VP 04604 GURIT ESSEX on the edge of the window (contact area with the adhesive) using the applicator supplied (see fig. 33) and thoroughly dry with a dry cloth.
12. Apply the glass primer Betaprime 5100 GURIT ESSEX on the edge of the window (contact area with the adhesive) using the applicator supplied and leave to dry thoroughly (minimum: 30 seconds).
13. Apply the metal plate primer Betaprime 5402 GURIT ESSEX on the window surround (contact area with the adhesive) using the applicator supplied and leave to dry thoroughly.
14. Cut the spout on the adhesive dispenser as shown in fig. 34 to obtain a triangular cross-section bead.
15. Apply a bead of polyurethane based Betamate 7120 Sprint ESSEX on the window (the cross-section of the bead must be triangular, with a 0.3937 in. (10 mm) base and 0.4724 to 0.5905 in. (12 to 15 mm) height).

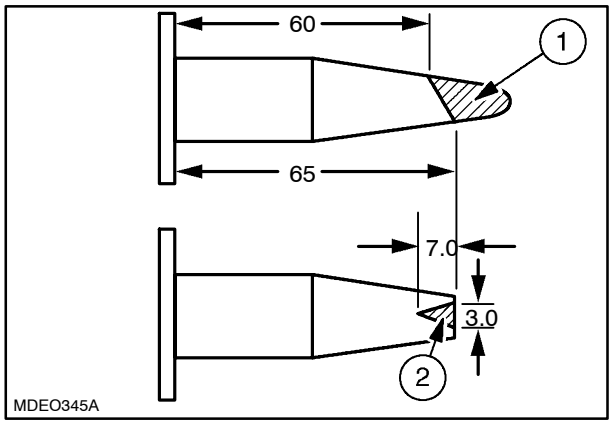
NOTE: *Make sure that there are no areas where adhesive is missing, otherwise water may penetrate.*

16. Using suction cups, position the windscreen and its surround, inserting support shims under the windscreen.
    Use clamps to apply uniform pressure, providing a 0.1574 in. (4 mm) thickness of adhesive and to ensure perfect adhesion.

NOTE: *Leave the clamps in place for 4 hours until the adhesive has completely polymerized.*
Definitive glue hardening will require a total of 48 hours.
The cab must, however, remain stationary during this period, to ensure correct windscreen installment.



33



34

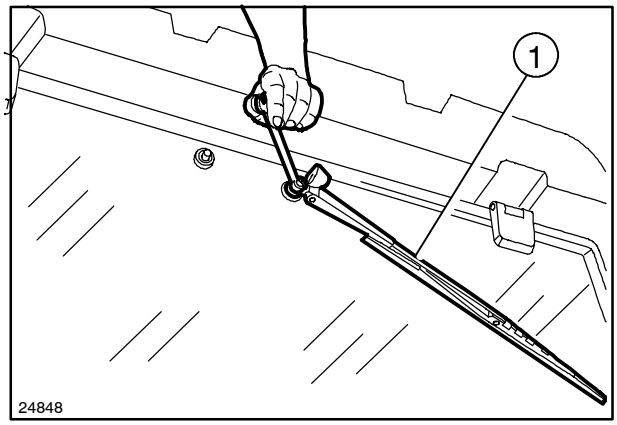
Op. 90 156 52
CAB REAR WINDOW
Replacement

Proceed as follows:

CAUTION

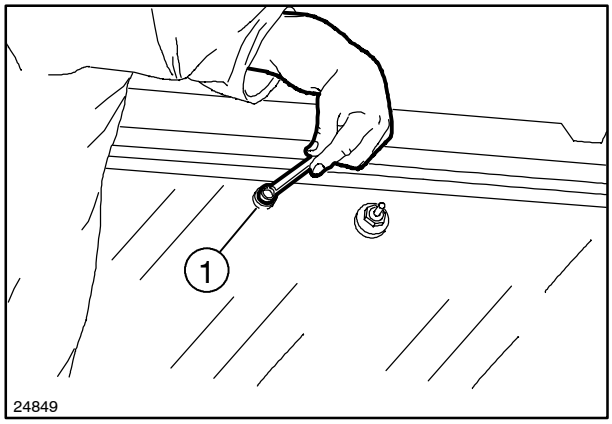
Handle all parts carefully.
Do not put your hands or fingers between parts.
Wear suitable safety clothing - safety goggles, gloves and shoes.

1. Working from the outside of the cab, remove the windscreen wiper blade (1).



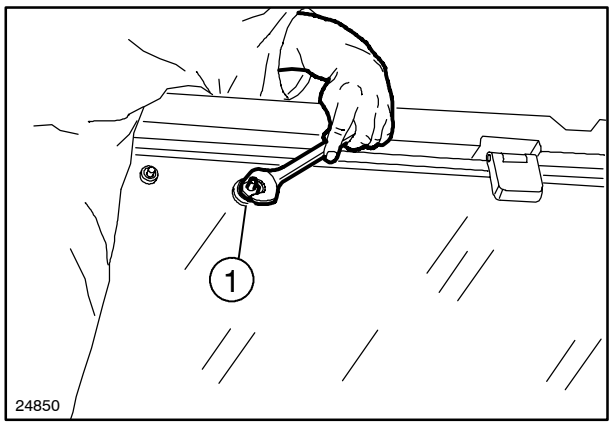
35

2. Unscrew the small nut (1) securing the windscreen wiper motor unit to the screen.



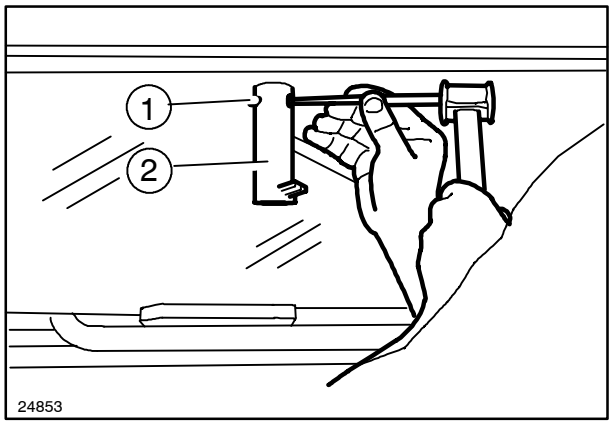
36

3. Unscrew the large nut (1) and extract the windscreen wiper motor unit from the screen, leaving the wiring connected.



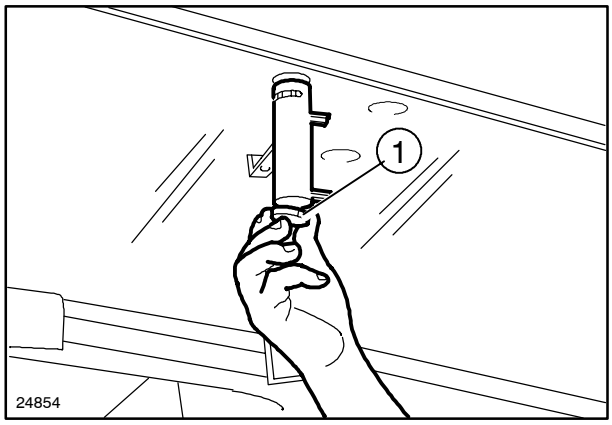
37

4. Working from inside the cab, open the rear windscreen, remove the rotation locking pin (1) on the handle (2).



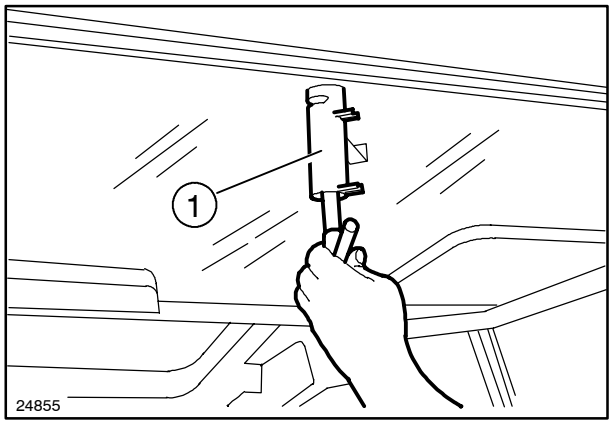
38

5. Remove the circular cap (1) on the end of the handle.



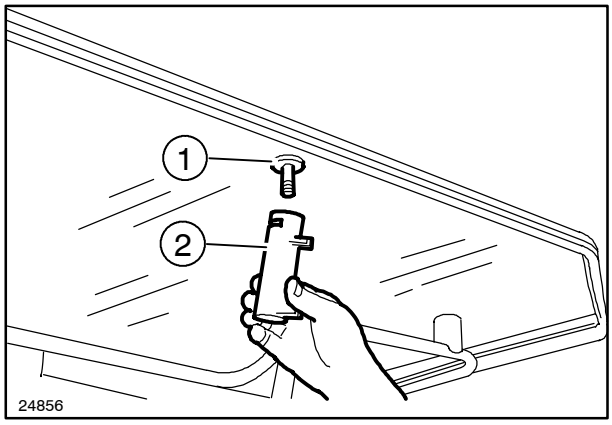
39

6. Using a pipe wrench unscrew the internal nut securing the handle (1) to the glass.



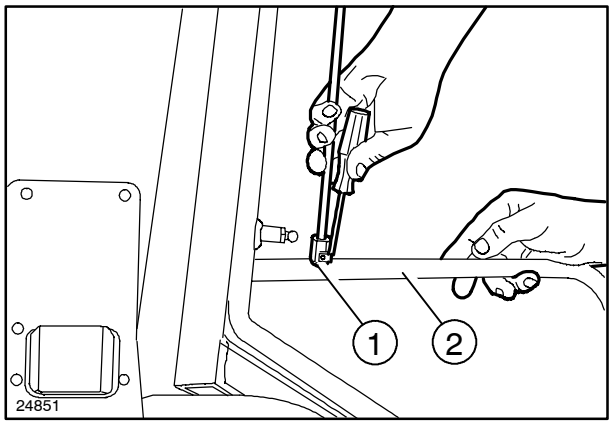
40

7. Remove the handle (2), seals and threaded pin (1).



41

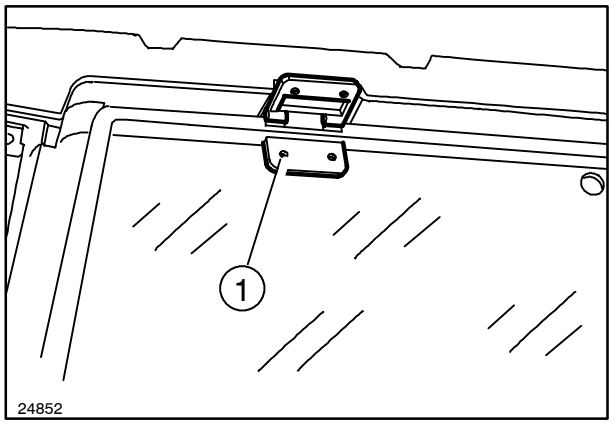
8. Disconnect the two gas spring terminals (1).



42

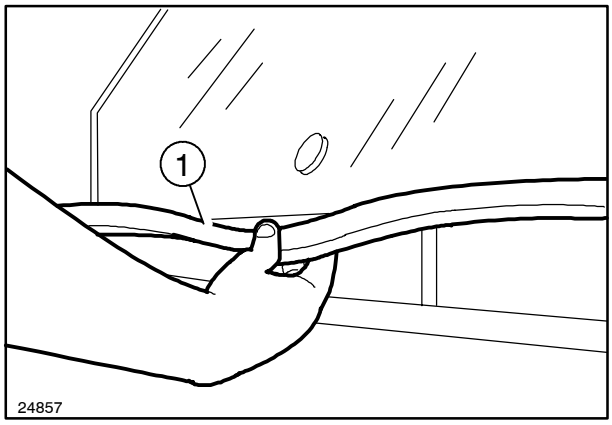
9. Unscrew the hinge (1) retaining bolts, remove the cab rear window together with the frame (2, fig. 42).

10. With the cab rear window removed, unscrew the retaining bolts and the frame (2, fig. 42).



43

11. Remove the rubber seal (1) on the rear window.



44

12. To assemble, proceed as follows:

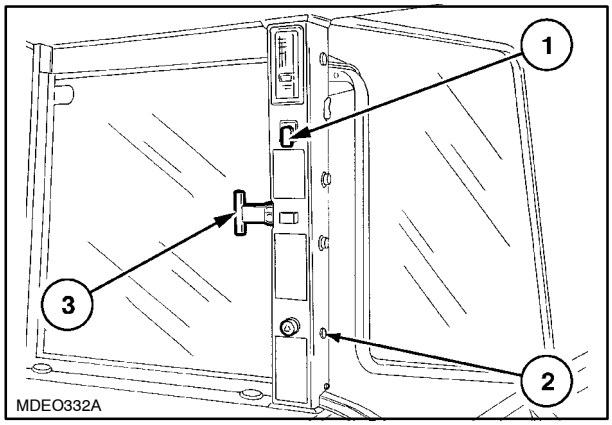
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Take the new rear window and refit or replace the seal on the outer edge of the screen.
- Refit the hinge and frame on the inside of the window.
- Refit the handle assembly.
- Reassemble the rear window wiper motor unit on the glass with the two retaining screws and refit the blades.
- Refit the rear window on the cab.

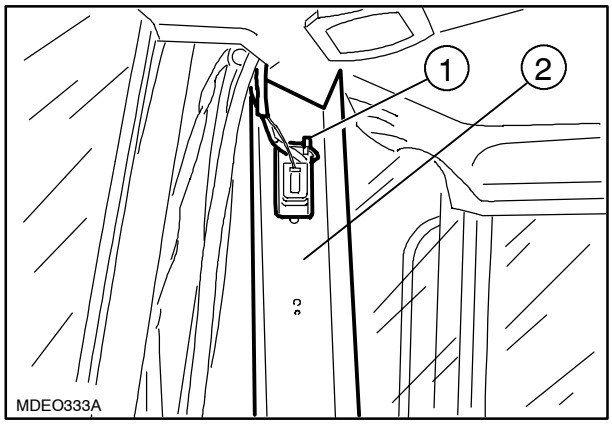
Op. 90 160 16
SEAL ON LH UPRIGHT
Replacement

1. Open the rear left-hand window with the handle (3), extract the pins (2) from the left-hand upright seal (1).



45

2. Disconnect the electrical connections (1) on the cab light and cigar lighter, remove the left-hand upright seal (2).



46

3. To assemble, proceed as follows:

⚠ CAUTION ⚠

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

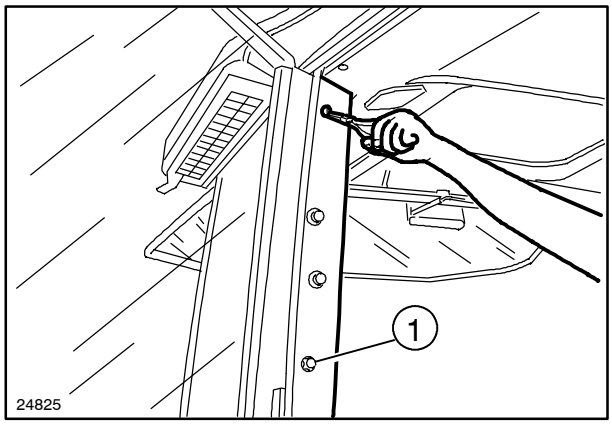
- Connect the electrical connections on the cab light and cigar lighter, on the left-hand upright seal.

- Fit the strip on the left-hand upright, insert the anchoring plugs and close the left-hand rear window with the handle.

Op. 90 160 16
STRIP ON RH UPRIGHT
Replacement

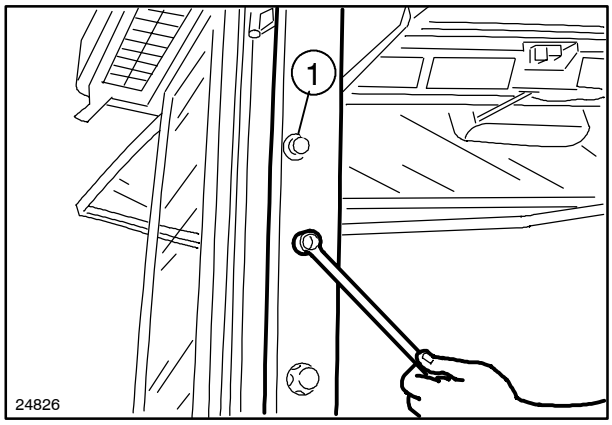
NOTE: *For TL series tractors up to frame no. 1228800, remove the right-hand side upright strip, as described in operations 1 to 7 here:*

1. Open the left-hand rear window with the handle, take out the plugs (1) anchoring the strip to the right-hand side upright.



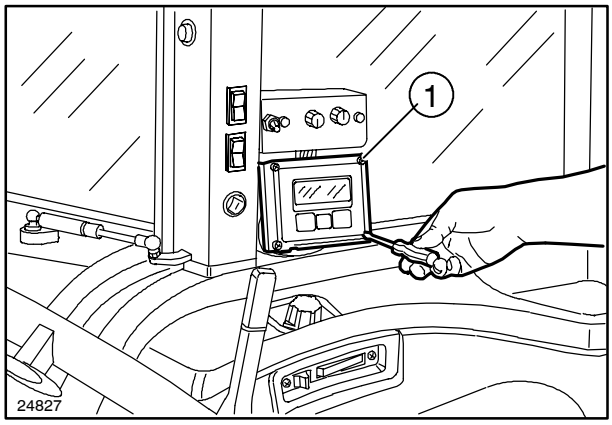
47

2. Take out the plugs and the two bolts (1) of the right-hand upright.



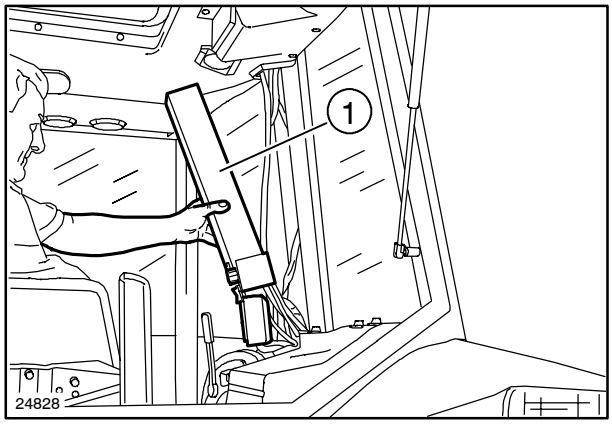
48

3. Take out the four bolts (1) securing the lid of the tractor's computer case.



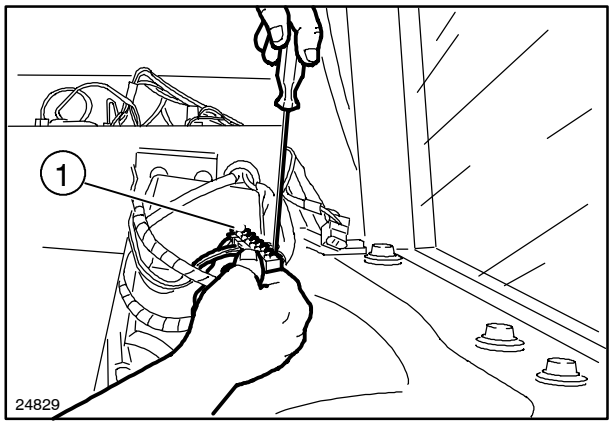
49

4. Pull out the right-hand upright trim (1).



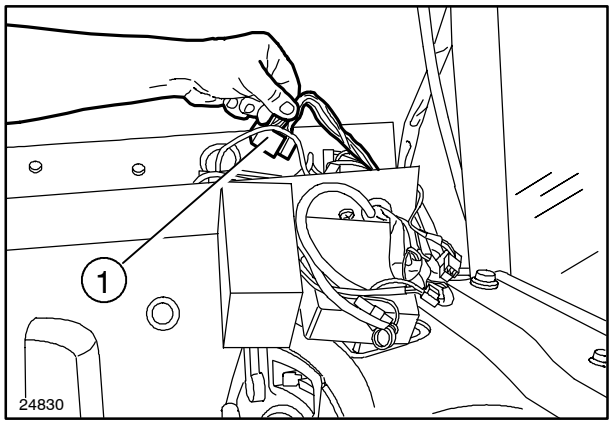
50

5. Disconnect all the electric wires from the terminal block (1).



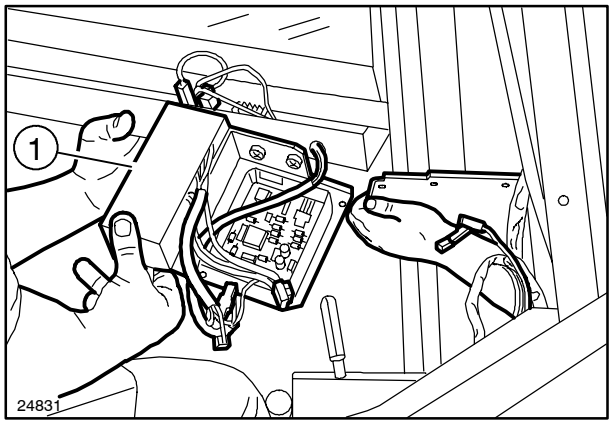
51

6. Disconnect the plug connections (1).



52

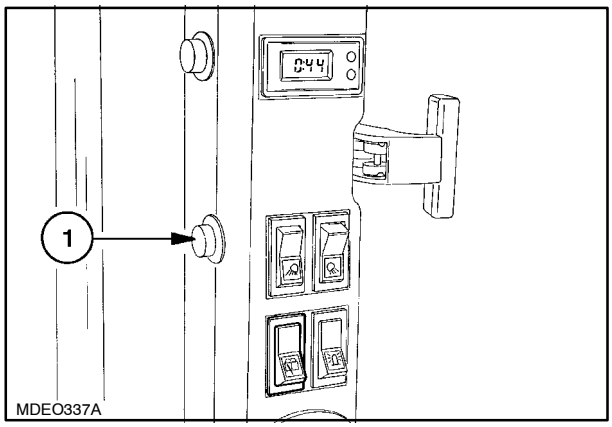
7. Take off the computer's rear cover (1) and disconnect the electric wires.



53

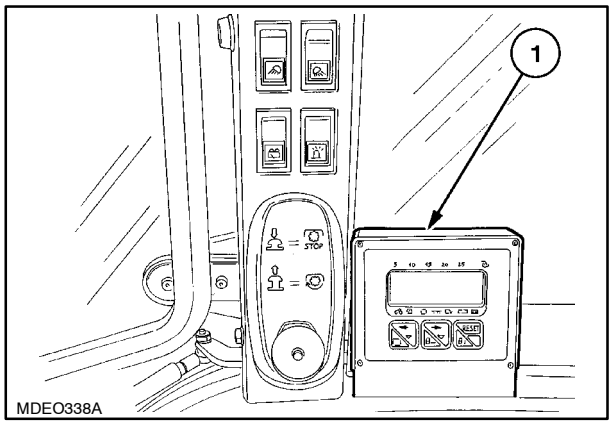
NOTE: *For TL series tractors as of frame no. 1228801, remove the right-hand side upright strip, as described in operations 8 to 12 here:*

8. Open the left-hand rear window with the handle.
9. Take out the plugs (1), caps and the two screws anchoring the strip to the right-hand side upright.



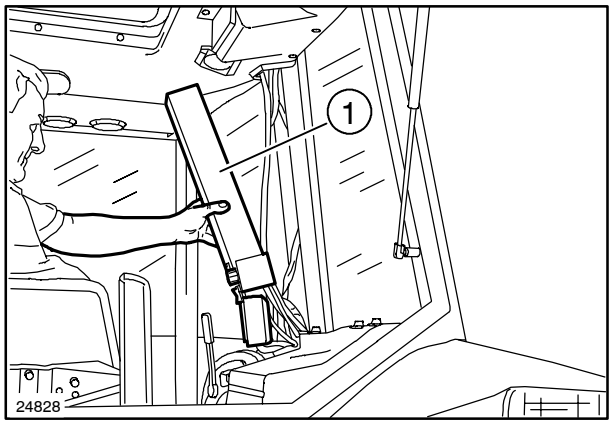
54

10. Unscrew the screws on the computer cover / casing (1).



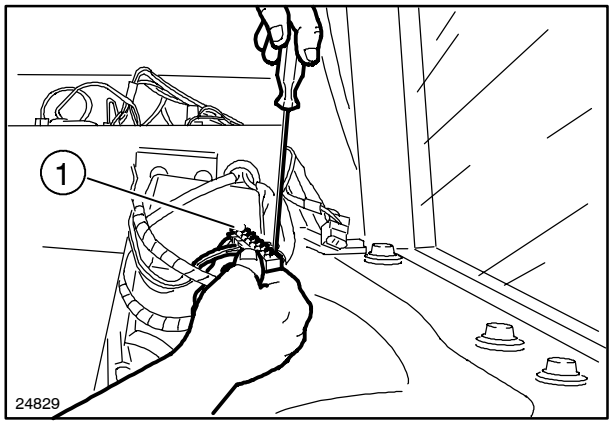
55

11. Pull out the right-hand upright trim (1).



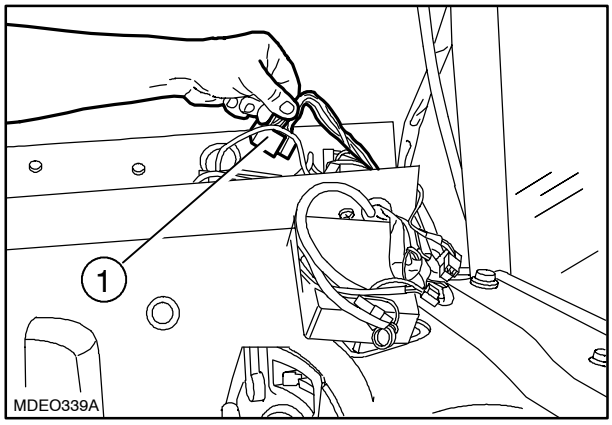
56

12. Disconnect the electrical connections on the terminal block (1).



57

13. Disconnect the plug connections (1).



58

14. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Reconnect the electrical connections to the computer's terminal block.

- Fit the retaining screws on the computer cover / casing.

- Fit the strip on the right-hand side upright.

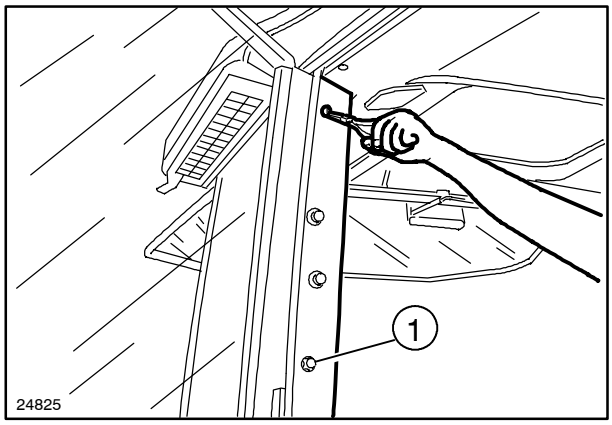
- Fit the plugs, caps and the two screws anchoring the strip to the right-hand side upright.

- Close the right-hand rear window with the handle.

Op. 90 160 42
FIXED PADDING ON RH WALL
Replacement

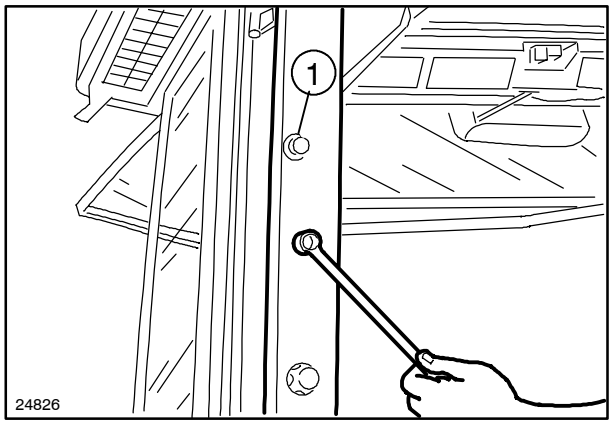
NOTE: *For TL series tractors up to frame no. 1228800, remove the right-hand side upright strip, as described in operations 1 to 10 here:*

1. Open the left-hand rear window with the handle, take out the plugs (1) anchoring the strip to the right-hand side upright.



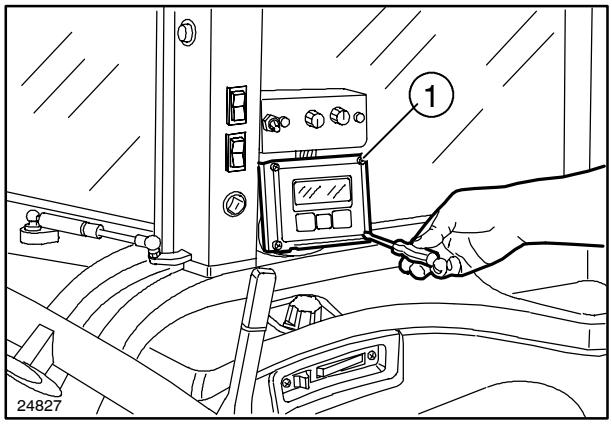
59

2. Take out the plugs and the two bolts (1) of the right-hand upright.



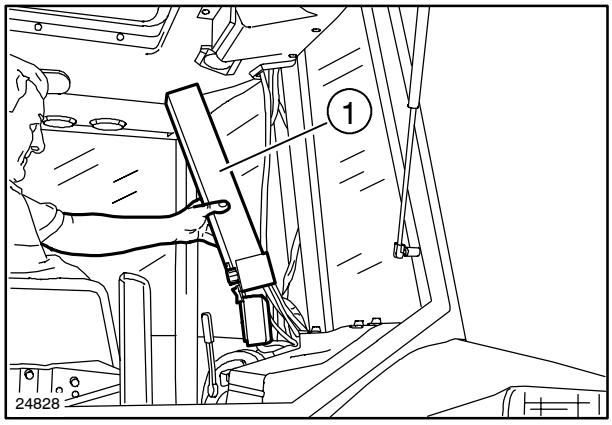
60

3. Take out the four bolts (1) securing the lid of the tractor's computer case.



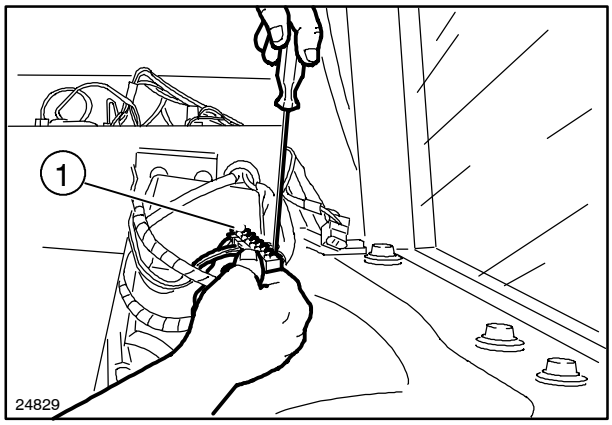
61

4. Pull out the right-hand upright trim (1).



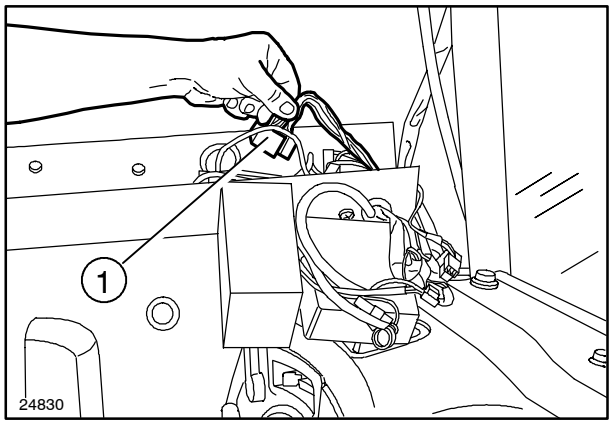
62

5. Disconnect all the electric wires from the terminal block (1).



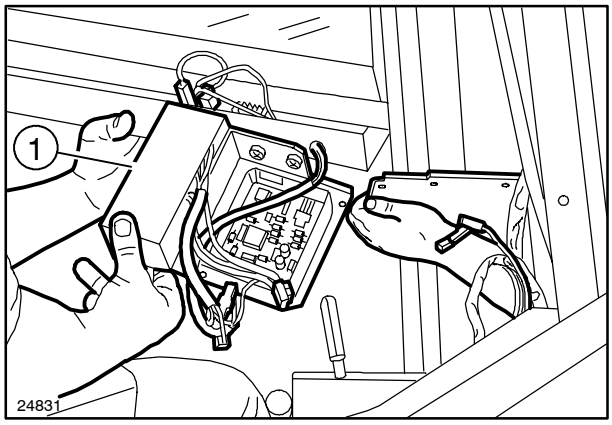
63

6. Disconnect the plug connections (1).



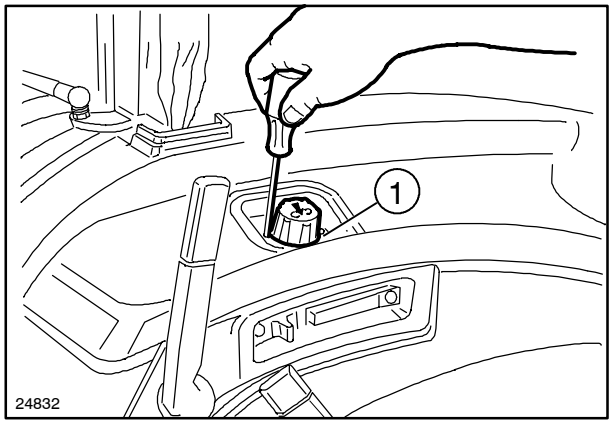
64

7. Take off the computer's rear cover (1) and disconnect the electric wires.



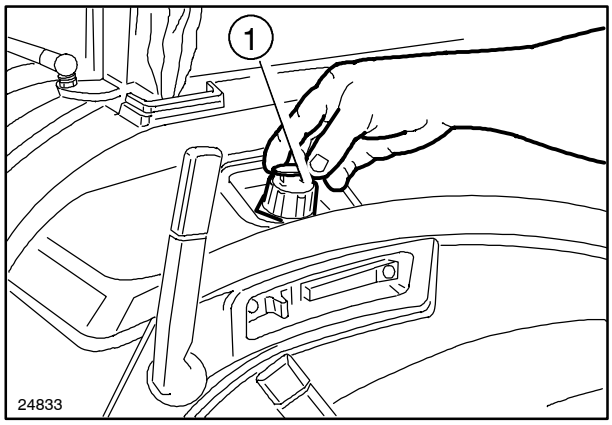
65

8. Take out the two bolts (1) securing the PTO control case.



66

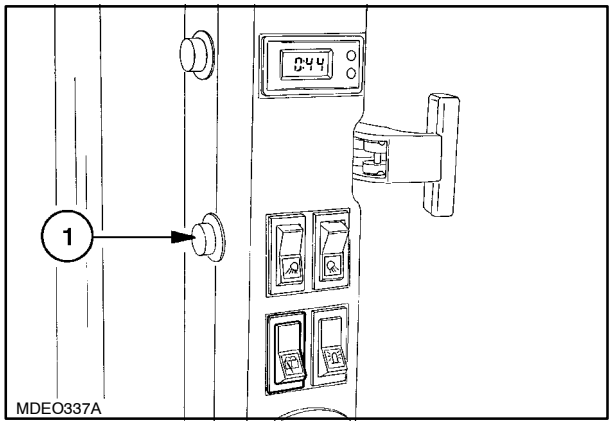
9. Remove the PTO knob (1), unscrewing it anti-clockwise, and remove the case.



67

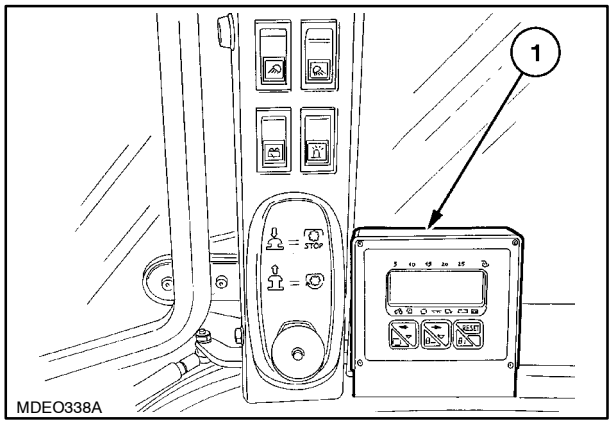
NOTE: *For TL series tractors as of frame no. 1228801, remove the right-hand side upright strip, as described in operations 11 to 15 here:*

10. Take out the plugs (1), caps and the two screws anchoring the strip to the right-hand side upright.



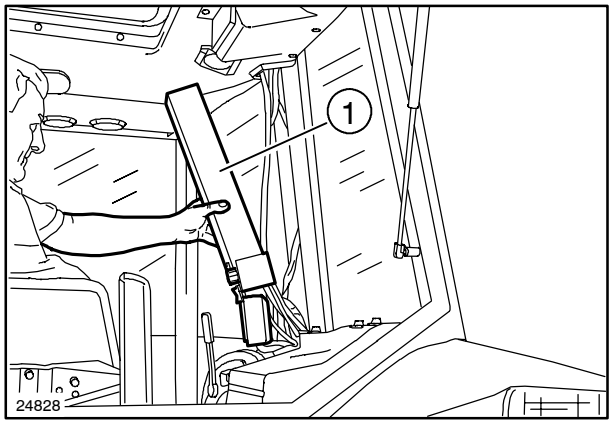
68

11. Unscrew the screws on the computer cover / casing (1).



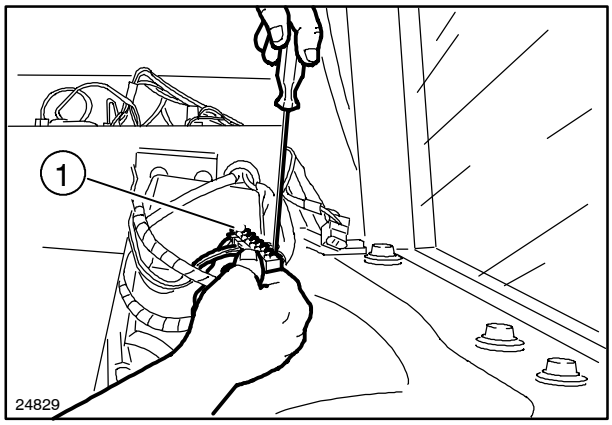
69

12. Pull out the right-hand upright trim (1).



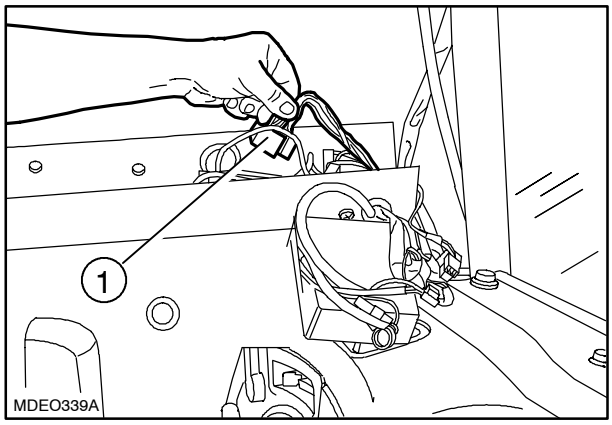
70

13. Disconnect the electrical connections on the terminal block (1).



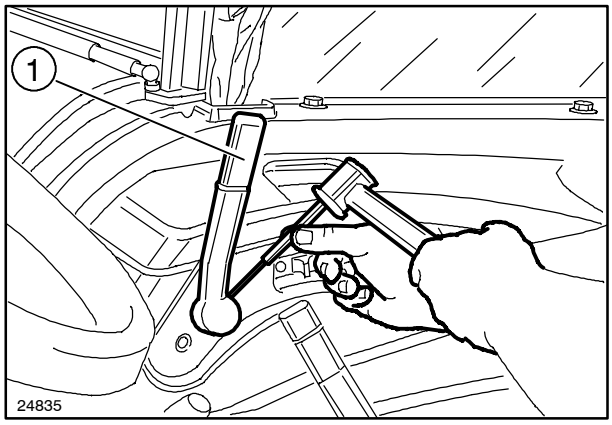
71

14. Disconnect the plug connections (1).



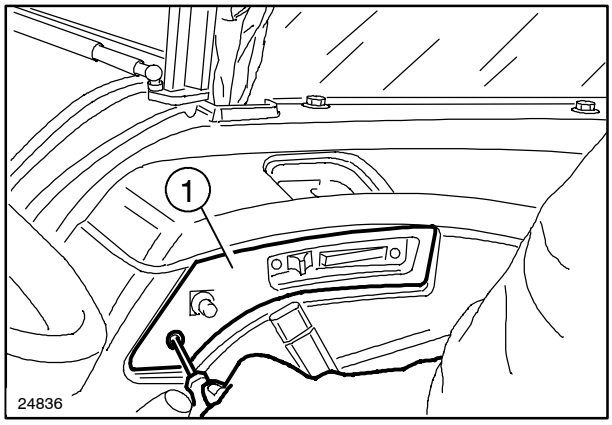
72

15. Extract the pin on the hand throttle lever (1) and remove the lever.



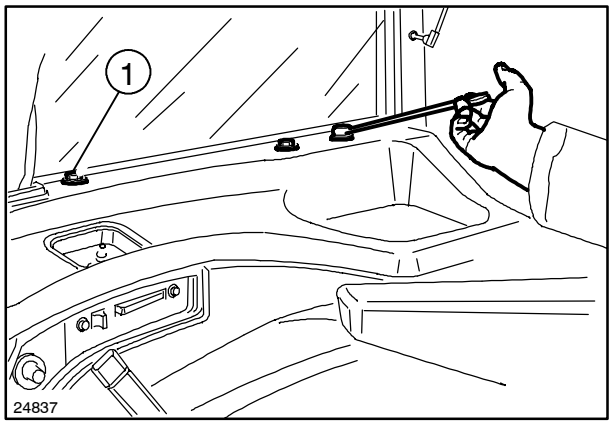
73

16. Unscrew the three screws securing the cover (1) on the LIFT-O-MATIC unit and remove the cover.



74

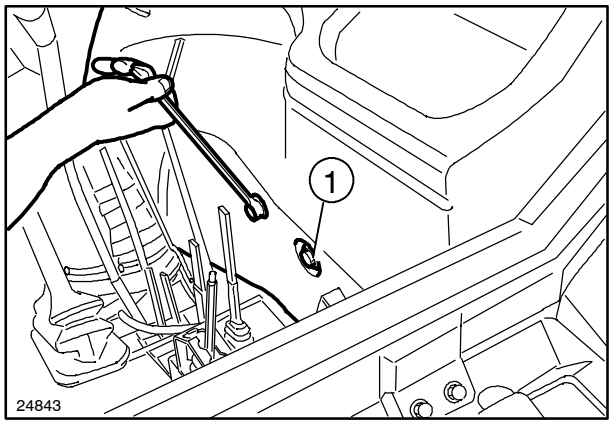
17. Remove the plastic caps and the screws (1) on the right-hand side panel.



75

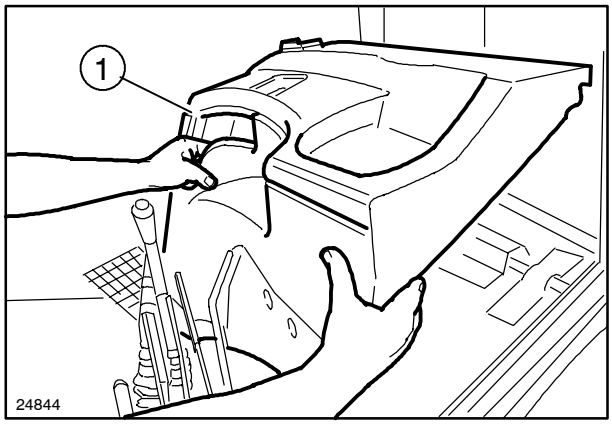
18. Carry out the disassembly sequences described in operation **90 160 50** for the **HYDRAULIC CONTROL LEVER GUARD**.

19. Unscrew the bolts (1) securing the right-hand side panel.



76

20. Remove the right-hand side panel (1).



77

21. To assemble, proceed as follows:

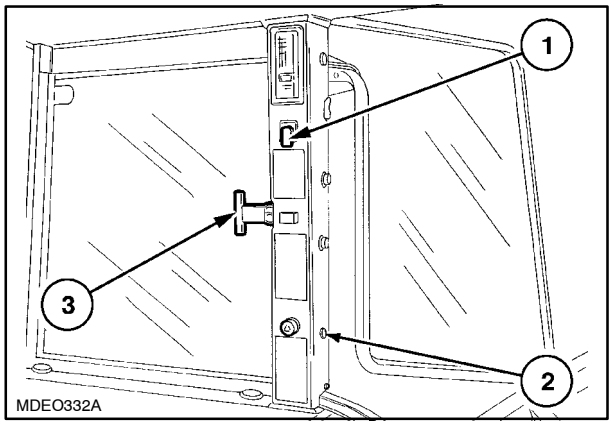
CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Fit the right-hand padding in place.
- Fit the screws retaining the padding on the right-hand wall and the plastic plugs.
- Carry out the assembly sequences described in operation **90 160 50** for the **HYDRAULIC CONTROL LEVER GUARD**.
- Fit the LIFT-O-MATIC (or PTO) control cover with the retaining bolts.
- Fit the throttle lever on by hand, on the pin, and insert the retaining pin.
- Reconnect the plug and electrical connections to the computer's terminal block.
- Fit the cover on the computer case, tightening the screws.
- Fit the trim on the right-hand upright.
- Fit the plugs and the two screws anchoring the strip to the right-hand side upright together with the caps.
- Close the left-hand rear window with the handle.

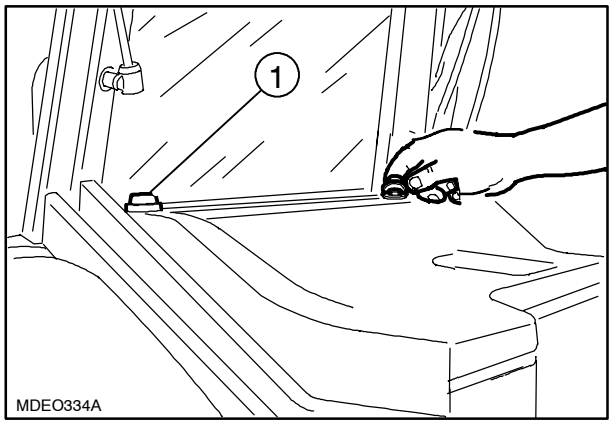
Op. 90 160 43
FIXED PADDING ON LH WALL
Replacement

1. Open the rear left-hand window with the handle (3), extract the pins (2) from the left-hand upright seal (1).



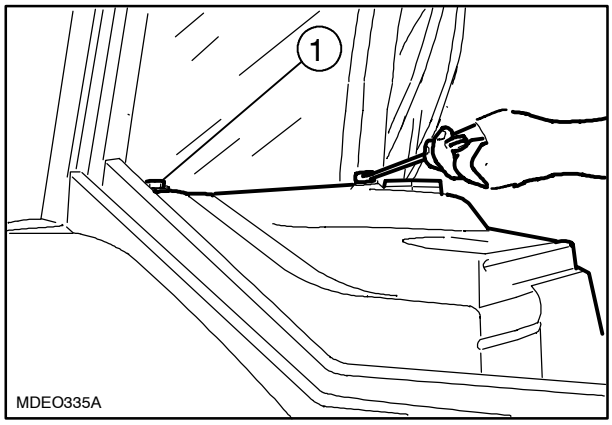
78

2. Remove the caps (1) covering the left hand panel retaining screws.



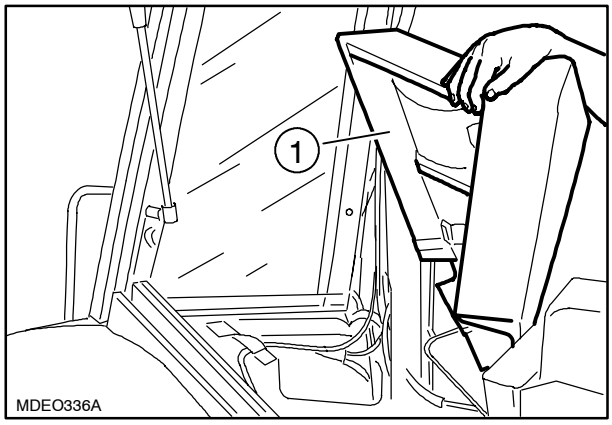
79

3. Remove the two screws (1) securing the left hand panel.



80

4. Remove the left-hand panel (1).



81

5. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Fit the left-hand padding in place.

- Fit in the two screws securing the left-hand padding.

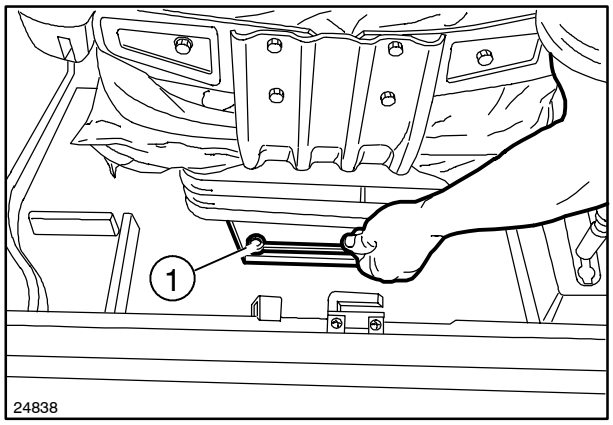
- Fit the caps on the screws securing the left-hand padding.

- Insert the plugs retaining the left-hand upright strip.

- Close the left-hand rear window with the handle.

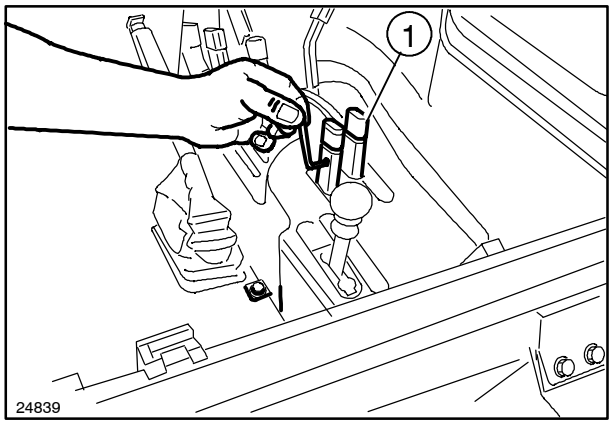
Op. 90 160 50
HYDRAULIC CONTROL LEVER GUARD
Replacement

1. Unscrew the bolts (1) securing the seat to the tractor bodywork, remove the seat and the covering underneath.



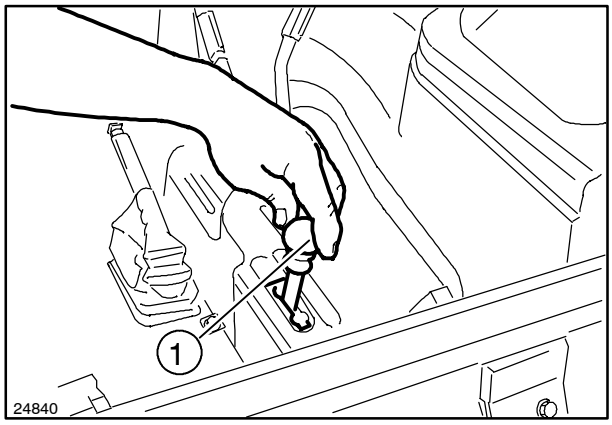
82

2. Unscrew the bolts securing the knobs (1) to the following control levers: lift, auxiliary control valves, creeper and synchronised PTO.



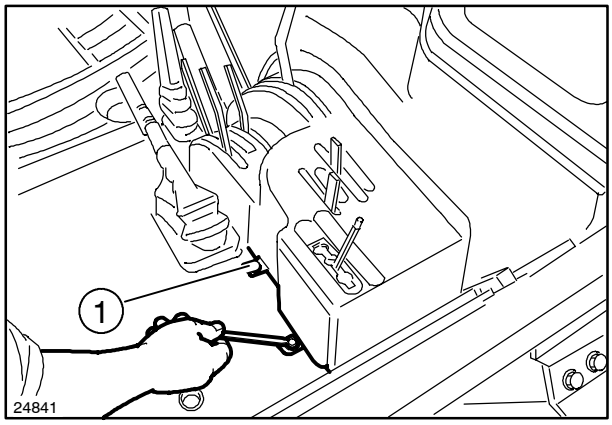
83

3. Remove the knob (1) on the PTO speed selection lever.



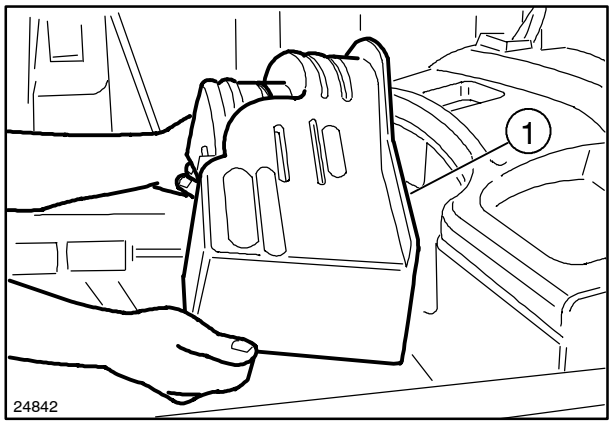
84

4. Unscrew the bolts (1) securing the guard covering the levers.



85

5. Disconnect the electrical connection on the two-pole plug and remove the guard (1).



86

6. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Connect the electrical connection to the two-pin plug fitted on the guard.

- Fit and secure the lever cover guard with the retaining screws.

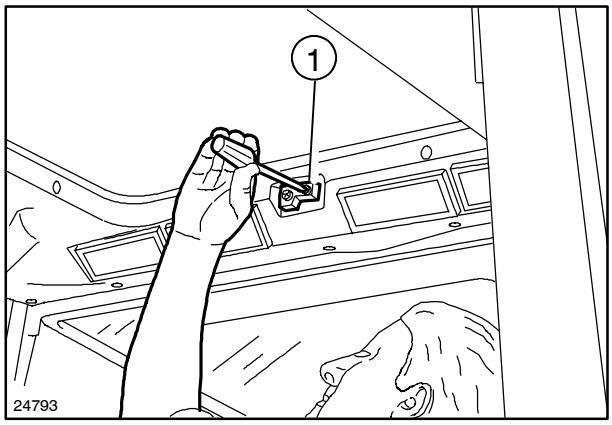
- Fit on the knob of the PTO speed selection lever.

- Fit the knobs on the control levers: lift, auxiliary control valves, creeper and synchronised PTO, and tighten the retaining bolts.

- Fit the seat on the platform of the bodywork and tighten the retaining bolts (1).

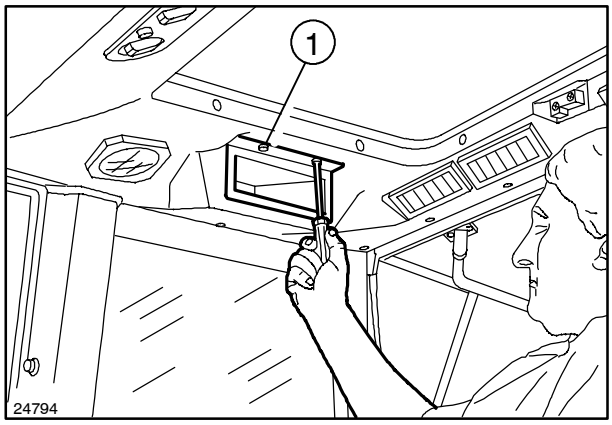
Op. 90 160 60
CAB CEILING TRIM
Replacement

1. Working from the inside of the cab, unscrew the bolts (1) on the roof hatch locking catch.



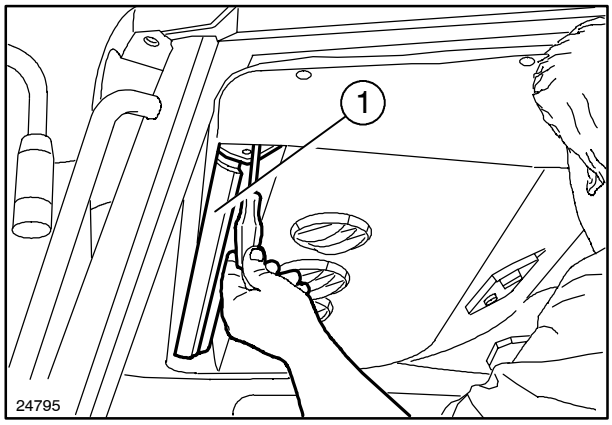
87

2. Unscrew the two screws on the radio compartment cover.



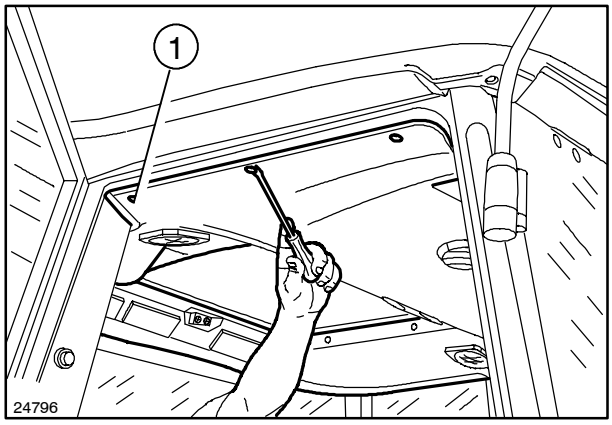
88

3. Unscrew the retaining bolts and remove the sun shade.



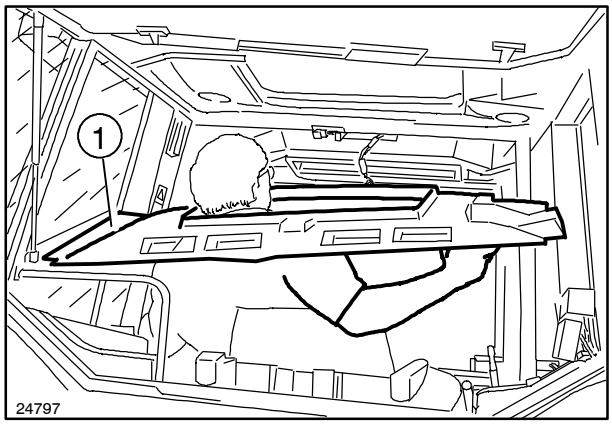
89

4. Remove the plastic pins (1) securing the cab ceiling trim.



90

5. Detach the cab ceiling trim (1) from the roof and disconnect the electrical connection on the front windscreen wiper motor.



91

6. To assemble, proceed as follows:

CAUTION

Always use appropriate tools to align fixing holes. NEVER USE FINGERS OR HANDS.

- Reconnect the electrical connection on the front windscreen wiper motor.

- Fit the ceiling trim and secure it to the cab with the plastic plugs.

- Fit the sun blind and secure by means of the relative bolts.

- Fit the radio compartment cover and secure it with the bolts.

- Fit the roof hatch locking catch and secure it with the bolts.